EFFECT OF DIFFERENT ORGANIC MANURESAND VARIETIES ON GROWTH AND YIELD OF SWEET PEPPER

SHARIKA HAYDER

DEPARTMENT OF HORTICULTURE
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

JUNE, 2020

EFFECT OF DIFFERENT ORGANIC MANURES AND VARIETIES ON GROWTH AND YIELD OF SWEET PEPPER

BY

SHARIKA HAYDER

REGISTRATION NO. 18-09154

A Thesis
Submitted to

The Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfilment of the requirements for the degree

Of

MASTER OF SCIENCE (MS)
IN
HORTICULTURE

SEMESTER: JANUARY-JUNE, 2020

Approved by:

Prof. Dr. A. H. M. Solaiman
Department of Horticulture
Sher-e-Bangla Agricultural University Dhaka -1207
Supervisor

Prof. Dr. Md. Nazrul Islam
Department of Horticulture
Sher-e-Bangla Agricultural University Dhaka - 1207
Co-supervisor

Prof. Dr. Md. Jahedur Rahman
Chairman
Examination Committee

Alhamdulillah

All praise to Almighty Allah

"my creator, my strong pillar and my source of inspiration"

Dedicated to –

My Beloved parents

"My love for you people shall live forever"

DEPARTMENT OF HORTICULTURE
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

Ref................. Date: ....

CERTIFICATE

This is to certify that the thesis entitled **“EFFECT OF DIFFERENT ORGANIC MANURES AND VARIETIES ON GROWTH AND YIELD OF SWEET PEPPER”**submitted to the Department of Horticulture, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **HORTICULTURE,** embodies the result of a piece of *bona fide* research work carried out by **SHARIKA HAYDER,** Registration No. **18-09154**, under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that such help or sources of information as has been availed of during the course of this investigation have been duly acknowledged.

Dated: June, 2020
Place: Dhaka, Bangladesh

Prof. Dr. A. H. M. Solaiman
Dept. of Horticulture
Sher-e-Bangla Agricultural University
Dhaka -1207

Supervisor

ACKNOWLEDGEMENT

All praises go to the Almighty Allah, the Supreme Ruler of the universe, who enabled the author to successfully completion of this research work.

The author would like to expresses her heartiest gratitude and thanks to her research Supervisor, ***Prof.Dr. A. H. M. Solaiman,*** *Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka 1207, for his scholastic guidance and constant encouragement during the entire period of the research work and in the preparation of the manuscript of the thesis.*

The author also cordially expresses her thankfulness and best esteems to respected Co-Supervisor ***Prof.*****Dr. Md. Nazrul Islam*****,*** *Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka 1207, for his, encouragement, prized advice, valuable suggestion, constructive criticisms, special help and co-operation during the occupancy of this research work, as well as preparing of this thesis and providing all the necessary facilities during entire period of this study.*

The author expresses his gratitude and indebtedness to all the honorable course teachers of Dept. of Horticulture, Sher-e-Bangla Agricultural University, for their sympathetic help and co-operation in various stages towards completion of this research work.

Finally, the author is deeply grateful to his beloved parents, brothers, friends and other well-wishers specially Sadman, Sujon, Sumonaand Troyee for their constant inspiration and moral support which can never be forgotten.

The Author

EFFECT OF DIFFERENT ORGANIC MANURESAND VARIETIES ON GROWTH AND YIELD OF SWEET PEPPER

ABSTRACT

A field experiment was conducted in the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka, during the period from October 2019 to April 2020, to find out the effect of organic nutrients and different varieties on the growth and yield of sweet pepper. The experiment consisted with two factors. Factor A: Four types of organic nutrient sources such as ON_0-Control (No fertilizer),ON_1-Cow dung (10 t/ha),ON_2-Kitchen compost (7 t/ha) andON_3-Vermicompost (5 t/ha). Factor B: Three varieties such as C_1-Peperone Yolo Wonder, C_2-F1 Hybrid Sweet Pepper (Lalima), and C_3-BARI Mistimorich2. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. For, organic manure ON_3 (vermicompost)gave the highest (11.89 t/ha) yield, while the lowest (6.07 t/ha) was found fromON_0. Besides, variety C_2produced the highest yield (10.94 t/ha) whileC_3produced the lowest (7.05 t/ha). For, combined effectON_3C_2produced the highest (14.06 t/ha) while ON_0C_3produced the lowest (4.43 t/ha) yield. So, Vermicompost with F1 Hybrid Sweet Pepper (Lalima)gave the best performance.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE NO.

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.

LISTOF TABLES

LIST OF PLATES

LISTOF FIGURES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATION AND ACCORONYMS

ABB REV IAT ION AN D AC CO RO NY MS

%	Percent
@	At the rate of
^0C	Degree Celsius
AEZ	Agro-ecological Zone
Agric.	Agriculture
ANOVA	Analysis of variance
BARI	Bangladesh Agricultural Research Institute
BCR	Benifite Cost Ratio
cm	Centi-meter
CV%	Percentage of Coefficient of Variation
cv.	Cultivar (s)
DAP	Days After Planting
DAT	Days After Transplanting
df	Degrees of Freedom
EM	Effective Microorganigm
et al.	And others
etc.	Etcetera
FAO	Food and Agricultural Organization
FYM	Farmyard manure
G	Gram (s)
g/sq.m	Gram per square meter
hr.	Hour (s)
HRC	Horticulture Research Centre
IARI	Indian Agricultural Research Institute
j.	Journal
Kg	Kilogram
Km	Kilometer
L	Litre
LSD	Least Significance difference
Max.	Maximum
mg/l	Miligram per litre
Min.	Minimum

ml	Mili-litre
ml/L	Mili-litre per litre
MOA	Ministry of Agriculture
No.	Number
NS	Non-Significant
OM	Organic manure
ppm	Parts Per Million
R	Residual effect
RCBD	Randomized Complete Block Design
Rep.	Replication
Res.	Research
RH	Relative Humidity
SAU	Sher-e-Bangla Agricultural University
SSB	Silicate Solubilizing bacteria
t/ha	Tons per hectare
TSP	Triple Super Phosphate
Univ.	University
var.	Variety
Via	By way of
Viz.	Namely

CHAPTER I

INTRODUCTION

Sweet pepper (*Capsicum annuum*) commonly known as Bell pepper or Green pepper belongs to thefamily Solanaceae and is native to Mexico with thesecondary center of origin at Guatemala and Bulgaria. It is now widely cultivated in Central and South America, Peru, Bolivia, Costa Rica, Mexico, in almost all the European countries, Hong Kong and India. In India, it is cultivated commercially in Tamil Nadu, Karnataka and Himachal Pradesh and in some parts of Uttar Pradesh. Pepper can be grown in the tropics preferably with a rainfall of 600-1200mm, temperature of about 18-270^{o} C, and a sandy loam soil which holds moisture fairly with a liberal supply of organic matter is ideal for the growth of pepper (Udoh *et al*., 2005).

Sweet peppers differ from common hot peppers in size and shape of the fruits, capsaicin content and usage. The fruits are non-pungent and have been widely used in immature or green stage as vegetable for stuffing or for salads. There are different types of peppers, and we used them as food vegetables, spices and in medicine. Sweet pepper is not known in a wild state and species commonly cultivated are *Capsicum annuum* known as sweet pepper, bell pepper, cherry pepper and green pepper (Messraen, 1992). Capsicum consists of approximately twenty-two wild species and five domesticated species. The five domesticated species include, *Capsicum annuum* L., *Capsicum baccatum* L., *Capsicum chinensis* L., *Capsicumpubescens* L., and *Capsicum frutescens* L., (Bosland & Votava, 2000). They include mild non pungent (sweet) varieties which are longer and have thicker flesh than the pungent ones (Aliyu *et al*., 1996).

Sweet pepper fruits are a rich source of vitamin C, polyphenols, chlorophylls, carotenoids, sugars 4.2 gm, (Flores *et al*.,2009) calories 31, protein 1gm, carbs 6gm, fiber 2.1gm, fat 0.3gm and water 92% in fresh bell pepper (Jadczak *et al*.,2010). Sweet peppers are chosen because of their high nutritive value and are rich source of vitamin C, bioflavonoid and 6-carotene. Peppers are rich in capsaicin that may help works against inflammation, they have powerful antioxidant properties.

Sweet pepper is considered a minor vegetable crop in Bangladesh and its production statistics is merely available (Hasanuzzaman, 1999). Small scale cultivation is found in peri-urban areas primarily for the supply to some city markets in Bangladesh (Saha and Hossain, 2001). Economically it is the second most important vegetables crop in Bulgaria (Panajotov, 1998) and is thought to be the original home of pepper. It has great demand in Japan, Thailand, Philippines, Taiwan, Egypt and other countries even in Bangladesh.

Conventional farm systems have been characterized by a high input of chemical fertilizer leading to qualitative deterioration of soil as well as agricultural yield. However, a growing awareness of the adverse impacts of inorganic fertilizers on crop production as well as increasing environmental and ecological concerns has stimulated greater interest in the utilization of organic amendments for crop production. Fertilizer is one of the major factors of crop production. Use of inorganic and organic fertilizers has assumed a great significance in recent years in vegetables production, for two reasons. Firstly, the need for continued increase production and per hectare yield of vegetables requires the increase amount of nutrients. Secondly, the results of a large number of experiments on inorganic and organic fertilizers conducted in several countries reveal that inorganic fertilizer alone cannot sustain the productivity of soils under highly intensive cropping systems (Singh and Yadav,1992).

Organic manures act not only as a source of nutrients and organic matter, but also increase microbial diversity and activity in soil, which influence soil structure and nutrients turnover, in addition to improvement in other physical, chemical and biological properties of the soil (Albiach *et al*., 2000). Thus, organic amendmentsmanures are environmentally benign and help in maintaining soil fertility as well as agricultural productivity.

Cow dung is an important organic manure. It is also called the life of soil and plays an important role for sustainable soil fertility and crop productivity. It plays an important role physical, chemical and biological properties of the soils and ultimately enhance the crop productivity. Well rotten cow dung is also a good source of plant nutrient. It not only provides nutrient but also improve the soil physical and chemical properties like porosity water-holding capacity. It has been widely used for increasing sweet pepper production. Among various organic products, vermicompost has been recognized as potential soil amendment. In addition, vermicompost is a product of non-thermophiles biodegradation of organic material by combined action of earthworms and associated microbes. It is a highly fertile, finely divided peat-like material with high porosity, aeration, water holding capacity and low C: N ratios. So, vermicompost is very essential for the growth and yield of sweet pepper. Kitchen compost is decomposed organic material, such as leaves, grass clippings, bones and kitchen waste. It provides many essential nutrients for plant growth and therefore is often used as fertilizer. On the contrary, kitchen compost also improves soil structure so that soil can easily hold the correct amount of moisture, nutrients and air. It is well known that it improves the texture of both clay soils and sandy soils, making either type rich, moisture retentive, and loamy. Again, it is found that kitchen compost is one of nature's best mulches and soil amendments Adhikari *et al.* (2016)

The investigation was designed to determine how three types of sweet pepper react to the different rates of three different organic manures application under expected open field scenarios. The objective of this research was to find out –

a. the effect of different organic manures on the growth and yield of three colored sweet pepper,
b. the optimum rates of organic manures that influence the growth and yield of sweet pepper and
c. the combined effect of different manures on some chemical properties of sweet pepper

CHAPTER II

REVIEW OF LITERATURE

Sweet pepper is an important vegetable in many parts of the world. It is sensitive to various environmental factors viz. temperature, humidity, light intensity and moisture for proper growth and yield. Many researches have been conducted on various cultural aspects of sweet pepper in different countries. Among various research works, investigations have been made in various parts of the world to determine the suitable organic manure and variety for practices for its successful cultivation. The organic manure plays an important role in capsicum production. Literature regarding the studies on effect of kitchen compost, vermicompost and cowdung on growth and yield of sweet pepper are scanty in Bangladesh. Sweet pepper, eggplant and tomato belonging to the same family have more or less same growth habit and nutrient requirements. Because of the limitation of published report on sweet pepper, relevant literature on tomato and eggplant is presented in this chapter along with sweet pepper. The available literatures related to the present study are reviewed here.

Review on plant growth and yield components

Abdulbaki (2019) investigated the efficacy of poultry manure on growth and yield of capsicum (*Capsicum annuum* and *Capsicum frutescens*) on 30 plots altogether each species having 15 plots. He found highest number of leaves (33.47), plant height (22.37cm), leaf area (152.45) for *Capsicum annuum* and for *Capsicum frutescens* the highest number of leave (33.80), plant height (28.03cm), and leaf area (254.23). The highest yield of *Capsicum annuum* was 8.53 and *Capsicum frutescens* was 7.40. The study found out that high application of poultry manure is favorable for growth of *Capsicum frutescens* but the highest yield showed for *Capsicum annuum*.

Akande *et al.* (2018) investigated the effect of organic manure on growth and yield of capsicum and he found that the highest plant height (18.26 cm), stem girth (0.64 cm), number of fruit yield (5.00) for pig dung. He also stated that the highest plant height (16.28 cm), stem girth (0.51cm), number of fruit yield (1.33) for poultry manure. From this experiment it was evident that the performance of pig dung on growth and yield of Capsicum was better than poultry manure.

Sharma *et al.* (2017) conducted an experiment in University of Parmar Horticulture and Science. The treatments comprised of 7 combinations of different nutrient source and it consisted of combined application of varied level of vermicompost, poultry manures and farm yard manures. In the present study, various combination of organic manure (FYM, vermicompost and poultry manure), PGPR were used in combination with varying levels of NPK along with priming of seeds with GA_3 100ppm for 48 hrs during the year 2014 and 2015. The observations were recorded on different growth and yield contributing traits. Among different treatment combination T_4 (25% FYM+ PM+ full FYM) gives maximum number of fruits (25.07), yield per plant (2.00kg), and yield per hectare (420.37q), longest harvest duration of 64.83 days and minimum days to flowering (44.25) and marketable maturity (69.33 days). This was closely followed by T6 (25% VC+ PM+ full FYM) which results in larger sized fruits (28.78 cm^2), a greater number of laterals (5.37) and vigorous plant (69.87cm). The benefit: cost ratio was obtained higher (2.27) in T4 because of more yield potential and remunerative price. The plots receiving RDF (control) having minimum growth and yield potential and also having lower benefit: cost ratio.

Tajungsola *et al.* (2017) conducted a field experiment at Higginbottom University of Agriculture Technology and Science, during rabi season 2016-1017 to study the effect of organic manures on growth and yield of capsicum. The experiment consisted of three

Bulky organic manures (FYM, Vermicompost and Poultry manure) and three chemical fertilizers (Nitrogen, Phosphorus and Potassium).The result revealed that maximum plant height (44.55 cm), number of leaves plant^{-1} (35.97), leaf area plant^{-1}(56.27 cm2), number of flowers plant^{-1} (10.53), number of fruit set (4.77), fruit length (7.50 cm), number of fruits plant^{-1} (4.37), average fruit weight (140.47 g/fruit) and fruit yield plot^{-1}(433.23 kg) were produced by treatment T6 (50% RDN + 50% Vermicompost ha-1) followed by T7 (25% RDN + 75% vermicompost-1) with plant height (42.40 cm), number of leaves plant-1 (34.10), leaf area plant-1 (54.20 cm2), number of flowers plant-1 (10.47), number of fruit set (3.80), fruit length (7.27 cm), number of fruits plant-1 (3.67), average fruit weight (138.37 g/fruit) and fruit yield plot-1 (1.93 kg). Similarly, treatment T6 showed higher nutrient availability in the soil with organic carbon (0.47%) and the residual nutrient status of nitrogen (106.08 kg/ha), phosphorus (23.83 kg/ha) and potassium (381.33 kg/ha). The maximum gross (Rs. 2557750 ha-1) and net return (Rs.199036.22 ha-1) were obtained in T6 and maximum benefit cost ratio (4.50) was obtained in T2 (75% RDN + 25% FYM ha-1).

Khandaker *et al.* (2017) observed that the effects of different organic fertilizers on growth, yield and quality of *Capsicum annuum* L. var Kulai (Red Chilli Kulai). Performance of chilli plant was assessed by application of different organic fertilizer (vermicompost (VC), chicken dung (CiD), peat moss (PM), fermented fish waste (FFW), and cow dung (CoD). Application of vermicompost and chicken dung shows highest growth, quality and yield performance. Control treatment (without organic fertilizer) showed the lowest growth, yield and quality response.

Adhikari *et al.* (2016) conducted an experiment with sweet pepper and found a significant result using vermicompost, poultry manure, farm yard manure, goat manure and commercial organic manure on pot media. He found quit similar result between vermi compost and poultry manure on plant height (38.5cm) VC and (38.7cm) PM and stem diameter (11.0 cm) VC and (11.9 cm) PM. He also found highest result for goat manure and commercial organic manure on plant height (28.0 cm) and (32.1 cm) and stem diameter (7.5 cm) and (8.5 cm). He also found the superior yield on behalf of vermicompost (36.6 g), poultry manure (35.9 g), goat manure (28.1 g), farm yard manure (32.0 g). The result revealed that vermi compost was better for sweet pepper growth and development as compared to other organic manures and chemical fertilizer use in this experiment.

Fabiyi *et at.* (2015) conducted an experiment with sweet pepper and found significant results using poultry manure on 8tha. He found highest plant height (42.4cm), stem girth (17.1mm), number of branches (21), number of leave (129.5), number of fruits per plant (17), fruitgirth (39.5) and pepper yield (20.09 tha^{-1}) experimented in 2014. In addition he also investigated another experiment in 2012 and got highest plant height (45.3cm),stem girth (18.3mm),number of branches (23),number of leave (135),number of fruit (21),fruit girth(40.1)and pepper yield (22.71 tha^{-1}) from this experiment it is evident that he got comparatively higher yield in 2012 rather than 2014 using poultry manure.

A pot experiment was executed by Awosika *et al.* (2015) to study the effect of organic manure and bio fertilizer (Mycorrhizal) on growth and yield of tomato. He also reported that the application of pig dung only at low rate increased agronomical properties of tomato plant (*Lycopersicon esculentum*).Inoculation with mycorrhizal and poultry manure application also showed increase when compared with poultry manure application. The growth increase is suggested to be attributed to mycorrhizal interactions which enhanced plant to acquire nutrient.

Ishtiyaq *et al.* (2015) investigated that different rates of vermicompost produced varied and significant effect (P\0.05) as compared to the control on germination, growth and yield parameters with maximum value recorded at 6 t/ha, followed by 4 t/ha and the least at 2 t/ha. The dose of 6 t/ha significantly (P\0.05) increased germination (22.56 ± 2.5 %), number of fruits per plant (3.55± 0.07) mean fruit weight (73± 5.0 g), yield per plant (1.48 ± 0.05 kg) and marketable fruits (28.66 ± 3.0 %) when compared with the control.

Rehman *et al.* (2015) observed that bio management of root knot nematode, *M. incognita* affecting chilli using non edible seed oil cakes is an effective and ecologically safer approach as a substitute of nematicides for the pollution free and sustainable environment.

In another experiment with capsicum growing under pot culture conducted under screen house, Adesina *et al.* (2014) found that pig dung and poultry manure application increase plant height when compared with poultry manure application especially at 5 and 7 weeks after transplanting.

Olawuyi *et al.*(2014) was reported that mycorrhizal inoculation with cow dung increased the agronomic characteristics of pepper plant. AMF aids in plant growth by increasing metabolic activities and accelerating transfer of nutrients from fungus to plants. Since, most crops species perform better with mycorrhizal inoculation, we suggest it enhanced the growth of pepper plants.

Ali *et al.* (2014) conducted an experiment to investigate the potential of vermicompost and mustard oil cake leachate as foliar organic fertilizer with reference to the growth, yield and TSS status of chilli and BARI hybrid tomato 8 and then examined their effects on different parameters. The experimental data revealed that significant increase in growth; yield and TSS on chilli and BARI hybrid tomato-8 were observed due to foliar application of vermicompost and mustard oil cake. All parameters performed better results with the foliar application of the leachate from vermicompost which was very close the mustard oil cake. However, maximum number of fruit, yield and TSS were found from the foliar application of leachate from vermicompost which was followed by mustard oil cake (28.4 /plant, 12.7 kg/plot and 4.2% respectively) whereas minimum from control.

Reshid *et al.* (2014) reported that a plastic pot set-up with soil was used to determine the effects and efficiency level of vermicompost on the growth and yields of tomatoes (*Solanum lycopersicum* L.). The study was conducted through effect of increasing concentration of Vermicompost (control, 10%, 20%, 30% and 40%w/w) in target plant growth. The obtained results from the present research indicated that applied vermicompost especially; at 20% level had significantly improving effects on better growth and development of vermicompost treated tomatoes as they had higher leaf area, leaf dry mass, fresh stem and dry weight, number of fruits and yields. Low doses of vermicompost (10%) and high doses (40%) produced lower yields of the tomato plants. Generally, the addition of vermicompost led to improve the yield of tomato cultivars as compared to control. Hence, it could be suggested that treated plants, with this vermicompost increased the growth, yield and the above chemical compositions and pH of the soil.

Khalid *et al.* (2013) conducted an experiment using six different organic amendments on strawberry (*Fragaria ananassa* Duch.) cv. Chandler which included T_1 = planting media (soil + silt + farm yard manure); T_2 = planting media + 400 mg/L humic acid; T_3 = planting media + 200 g /kg leaf manure; T_4 = planting media + 200 g/kg vermicompost; T_5 = planting media + 200 g/kg plant fertilizer and T_6 = planting media + 200 g/kg bio-compost. Hence farm yard manure (FYM) and vermicompost based organic amendments enhanced vegetative growth and improved quality of strawberry fruits.

Kumar *et al.* (2013) reported that organic manures proved to be superior when compared to the fertilizers as regards pest incidence. Vermicompost was significantly more effective as regards fruit borer infestation. NSKE 5% extract proved to be the most effective against fruit borer. Neemgold (*Azadirachtin*) 5 ml/l, *Pongamia glabra* 5% leaf extract and *Annona squamosa* 5% leaf extract also were effective in reducing the fruit borer incidence. *Murraya koenigi* 5% extract and chilli-garlic 5% extract were less effective. Significantly highest marketable yield was obtained in Neemgold (*Azadirachtin*) 5 ml/l followed by NSKE 5%.

Mamta *et al.* (2012) conducted an experiment on the effect of vermicompost on the growth and productivity of chilli plant. The vermicompost of cowdung, garden waste and kitchen waste in combination were used with chilli plants under field conditions. The different treatments affected the seed germination of the test crop significantly. Plant height, number of branches, number of leaves, number of flowers and fruit weight were higher in the vermicompost treated field as compared to control and no disease incidence was observed in the fruits of vermicompost treated plot. The study revealed that vermicompost amendments affected chilli crop differently and we recommend that while raising chilli crop farmers should use vermicompost instead of synthetic fertilizers.

Lallawmsanga *et al.* (2012) conducted an experiment and said that the ameliorating effect of vermicompost and cowdung compost on growth and biochemical characteristics of *Solanum melongena* treated with paint industrial effluent was evaluated in this study. The color and odor of the effluent samples, physical and chemical parameters like pH, EC, TDS, TS, EC and heavy metals were analyzed. The effluent contained sulphates, chlorides, phosphates, dissolved solids and other pollutants in higher amounts. The effect of effluent with water, vermicompost and cowdung were studied on shoot length, root length, leaf area, fresh weight, dry weight and biochemical parameters like Chlorophyll a, Chlorophyll b, Total Chlorophyll and Carotenoids of *S. melongena.* There was no change in the chlorophyll content on 80% effluent with vermicompost when compared to the control, whereas reduction in the carotenoids content was noted in 80% effluent with vermicompost.

Ikeh *et al.* (2012) also was reported increase in plant height of tomato and pepper respectively when soil was amended with poultry manure. Manure serves as source of organic matter which is easily mineralized and readily available for plant utilization. There was a general increase in stem girth of pepper plant with organic manure application and AM in the soil.

In an experiment with sweet pepper Fawzy *et al.* (2012) evident the effect of organic fertilizer on growth and yield of sweet pepper under field conditions in the two successive seasons of 2009 and 2010 at the Agricultural Experimental Station of the National Research Centre, EL-Nubaria, El -Behira Governorate, North Egypt. He found significant results using poultry manure (Organic 100 %) and Mineral nitrogen fertilizer (Mineral 100%) and combined application (50 % poultry manure +50% mineral fertilizers) with or without Bio-N fertilizer (Microbin and Biogen) on growth, yield, quality and chemical contents of sweet pepper fruits. He found highest plant height (53.30 cm), number of leaves (64.00), number of stems (6.50) and yield (8.67 ton/fed) on behalf of poultry manure in 2009. In addition, he also investigated another experiment in 2010 and he got highest plant height (60.34cm), number of leaves (70.23), number of stems (7.00) and yield (9.58 ton/fed). From this experiment it is evident that he got comparatively higher yield in 2010 rather than 2009 using poultry manure.

Meena *et al.* (2012) conducted an experiment and came to a conclusion based on 2 years of this experiment that reduced dose of chemical fertilizers up to 25-50% can give higher yield and better-quality fruits with more benefit cost ratio as compared to solely use of inorganic fertilizers. Further the sustainability in yield and soil can be achieved by conjoint application of organic and inorganic fertilizers which benefit the farmers on long run.

Nileema *et al*. (2011) conducted an experiment at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to study the influence of liquid organic manures viz., panchagavya, jeevamruth and beejamruth on the growth, nutrient content and yield of tomato in the sterilized soil during kharif 2009. The various types of organic solutions prepared from plant and animal origin are effective in the promotion of growth and fruiting in tomato. The Panchagavya is an efficient plant growth stimulant that enhances the biological efficiency of crops. It is used to activate biological reactions in the soil and to protect the plants from disease incidence. Jeevamruth promotes immense biological activity in soil and enhance nutrient availability to crop. Beejamruth protect the crop from soil borne and seed borne pathogens and also improves seed germination. In the present study, significantly highest plant growth and root length was recorded with the application of RDF + Beejamruth + Jeevamruth + Panchagavya and it was found to be significantly superior over other treatments. The application of Beejamruth + Jeevamruth + Panchagavya was next best treatment and resulted in significantly highest yield as compared to RDF alone.

Handa *et al.* (2011) Field trials were conducted a field trials where using different fertilizers having equal concentration of nutrients to determine their impact on different growth parameters of tomato plants. Six types of experimental plots were prepared whereT_1 was kept as control and five others were treated by different category of fertilizers (T_2-Chemical fertilizers, T_3-Farm Yard Manure (FYM), T_4-Vermicompost, T_5 and T_6- FYM supplemented with chemical fertilizers and vermicompost supplemented with chemical fertilizer respectively).The treatment plots (T_6) showed 73% better yield of fruits than control, Besides, vermicompost supplemented with N, P, K treated plots (T_5) displayed better results with regard to fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant from other fertilizers treated plants.

Hatamzadeh *et al.* (2011) observed the effects of vermicompost on growth and productivity of chilli. plants grown in a container medium including 50% pumice, 30% charcoal, 10% vermiculite and 10% peat moss, which was basic plant growth medium substituted with 10%, 20%, 30% and 40% (by volume) vermicompost besides control consisted of container medium alone without vermicompost Greatest vegetative growth resulted from substitution of container medium with 30% and 40% vermicompost and lowest growth was in potting mixtures containing 0% vermicompost.

Cristina *et al.*(2011) reported that vermicompost can be described as a complex mixture of earthworm faeces, humified organic matter and microorganisms that when added to the soil or plant growing media, increases germination, growth, flowering, fruit production and accelerates the development of a wide range of plant species. The enhanced plant growth may be attributed to biologically mediated mechanisms such as the supply of plant growth regulating substances and improvements in soil biological functions. Stimulation of plant growth may depend mainly on biological characteristics of vermicompost, plant species used and cultivation conditions.

Ali *et al.* (2011) shows the effect of Panchagavya and Sanjibani, liquid organic manure on the yield of green gram (*Vigna radiata*), chilli (*Capsicum frutescens*) and mustard (*Brassica campestris*). Their efficacy was compared by studying the yield contributing characters like plant height, primary branch, secondary branch/plant, number of seed/fruits, fruit length, weight of 100 seed, yield/plant, yield m-2 and experimental observation recorded that the Sanjibani and Panchagavya treated crops were higher than the control. A liquid manure specifically Sanjibani used in this study was pre-analysed to study the variation in microbial population between two Sanjibani sample prepared by using raw 9 materials (Cow dung and Cow urine) obtained from two different source of cow breed (i.e., Native breed and Jersey breed) and the best source of breed was selected for the further research work. Meanwhile the effect of organic farming practice in soil-health was also studied by analysing the basic parameters of soil in the field were the research was conducted. The result shows increased microbial population, oxidisable organic carbon, nitrogen, phosphate, potash. The pH and E.C were found to be close to neutral.

Goutam *et al.* (2011) conducted field trials using different fertilizers having equal concentration of nutrients to determine their impact on different growth parameters of tomato plants. Six types of experimental plots were prepared where T1 was kept as control and five others were treated by different category of fertilizers (T2-Chemical fertilizers, T3-Farm Yard Manure (FYM), T4-Vermicompost, T5 and T6- FYM supplemented with chemical fertilizers and vermicompost supplemented with chemical fertilizer respectively).The treatment plots (T6) showed 73% better yield of fruits than control, Besides, vermicompost supplemented with N P K treated plots (T5) displayed better results with regard to fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant from other fertilizers treated plants.

Singh *et al.* (2010) studied that Fruits having longer shelf life can be transported to distant markets whereas fruits with poor shelf life are vulnerable to long distance transport and disease injury. In country like India, it assesses greater importance because more than 30 per cent produce goes waste during post-harvest handling. In our study, maximum shelf life (15.00 days) was recorded in T5 (50% N + FYM + PM + P and K +PGPR) which was statistically at par with T7 (50% FYM+ 50% VC +PM) (14.00 days) and T3 (13.92 days). The possible reason for better shelf life may be attributed to better and vigorous growth resulting into fruits with more pericarp thickness. Being a climacteric fruit, ethylene release is obvious to start fruit ripening as the water content and ethylene concentration plays an important role in post-harvest life of fruits.

Sathish *et al.* (2009) carried out an experiment to evaluate biological activity of organic manures against tomato fruit borer, *Helicoverpa armigera* (Hub.) and safety of otanicals and biopesticides against egg parasitoid, *Trichogramma chilonis Ishii* and biochemical effects of *Pseudomonas florescens* on tomato under pot culture conditions. The feeding and infestation of the larvae of *Helicoverpa armigera* were significantly low in farm yard manure (FYM) Azospirillum + silicate solubilising bacteria (SSB) + Phosphobacteria + neem cake applied plants followed by FYM + Azospirillum + SSB + Phosphobacteria + mahua cake applied plants. *Trichogramma parasitization* on *Helicoverpa armigera* eggs was adversely affected by neem oil 3% on treated plants followed by neem seed kernel extract (NSKE 5%) + spinosad 75 g a.i./ha. Under laboratory condition among the microbial pesticide tested Spinosad (75 g a.i. /ha), HaNPV + Spinosad + Bt (1.5×1012 POBs/ha + 75 g a.i. /ha + 15000 IU/mg (2 lit/ha)), Spinosad + Bt (75 g a.i. /ha + 15000

IU/mg-2 lit/ha) showed higher insecticidal toxicity (100 per cent mortality on 72 h) to all instars of *Helicoverpa armigera* larvae. Biochemical parameters like phenol content, peroxidase and phenyl alanine ammonialyase (PAL) activity recorded higher levels in *Pseudomonas florescens* seed treatment @ 30 g/kg of seed and its foliar spray @ 1 g/litre in treated tomato plants.

In an experiment with sweet pepper Amor (2006) used organic fertilizer and the experiment comprise with three treatment (conventional, integrated and organic farming). The author studied the yield and fruit quality of sweet pepper and he found the highest total marketable yield (7.33 kgm) and non-marketable yield (1.40 kgm). The result revealed that incase of organic fertilizer from both environmental and economic perspective it maintains the yield of fruit under nutrient depletion at later stages of development.

Fioreze *et al.* (2006) conducted a study was conducted in Rio Grande do Sul, Brazil to determine the organic sources of nutrients in potato production systems. The treatments include hen and hog residue and mineral fertilizers. Results indicated that organic sources are economical and technical alternatives to chemical fertilizers. However, their efficiency is maximized when coupled with chemical fertilizers, mainly to maintain nitrogen supply along the crop cycle, especially in the case of using hog residues. Hen residue is better than hog residue because it has higher amount of nutrients.

Singh *et al*. (2006) conducted a field experiment at Central Potato Research Station, Gwalior, Madhya Pradesh, India, during the winter seasons (rabi) of 2001- 02 and 2002 - 03 to study the effect of organic and inorganic sources of nutrients on potato (*Solanum tuberosum*) production. The treatments included 25, 50, 75 and 100% doses of NPK with and without organic manures (farmyard manure (FYM) and Nadep compost at 30 t/ha). Application of 100% NPK + 30 t FYM/ha resulted in significantly higher tuber yield of 456 q/ha compared with that of other treatments except 100% NPK + 30 t Nadep/ha and

75% NPK + 30 t FYM/ha. The effect of organic manures (FYM and Nadep compost) in combination with inorganic fertilizers was more pronounced compared with that of organic manures alone. However, FYM was more effective than Nadep compost in producing higher tuber yield. Maximum net return of Rs 63 627/ha was also obtained from 100% NPK + 30 t FYM/ha. However, benefit cost ratio was almost same under 75% NPK with 30 t/ha FYM or Nadep compost and 100% NPK with 30 t/ha FYM or Nadep compost.

Kushwah *et al.* (2005) conducted an experiment during rabi 2004/05 on silty clay loam soil at Gwalior, Madhya Pradesh, India to study the effect of farmyard manure (FYM), Nadep compost, vermicompost and inorganic NPK fertilizers on yield and economics of potato. Application of FYM, Nadep compost and vermicompost alone or in combination did not influence tuber yield significantly. However, organic manures at 7.5 t/ha in combination with 50% recommended dose of NPK significantly increased tuber yield. The highest tuber yield (321 q/ha) was recorded with 100% recommended dose of NPK fertilizers. The highest incremental benefit cost ratio (7.5) was obtained with 50% recommended dose of NPK

.

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted in the Horticulture of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from October, 2019 to April 2020 to find out the effect of different organic nutrients and fruit varieties on the growth and yield of sweet pepper. The materials and methods which were used for conducting the experiment are presented under the following headings:

3.1. Description of Experimental site

3.1.1. Experimental location

The present experiment was carried out in the Horticulture Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka Bangladesh. The location of the experimental site was 23°741N latitude and 90°351E longitude and at an elevation of 8.2 m from sea level (BARI., 1989)**Appendix I**.

3.1.2. Climate and weather

The area is characterized by hot and humid climate. The average rainfall of the locality during experimental period was very little; the minimum and maximum temperature was 19.19°C and 28.81°C respectively as the average of 24°C. Average relative humidity was 68%. During the period from December to January, the humidity was low; temperature was mild with plenty of sunshine. The atmospheric temperature increased from February as the season proceeded towards. The experimental area was under the sub-tropical monsoon climatic zone, which is characterized by little amount of rainfall, low humidity, low temperature and short-day during Rabi season (15th October to 15th March). At that time, the details of the meteorological data in respect of temperature, rainfall, relative humidity during the period of experiment were collected from meteorological department, Agargaon, Dhaka are in **Appendix II.**

3.1.3. Characteristics of soil

The soil of the experimental field belongs to the Tejgaon series under the Agro ecological Zone, Madhupur Tract (AEZ-28) and the General Soil Type is Deep Red Brown Terrace Soils. A composite sample was made by collecting soil from 12 several spots of the field at a depth of 0-15 cm before the initiation of the study. The collected soil was air-dried, grind and passed through 2 mm sieve and analyzed at Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka for some important physical and chemical properties. The soil was having a texture of sandy loam with pH and organic matter capacity 5.6 and 0.78%, respectively and the soil composed of 27% sand, 43% silt, 30% clay. Details descriptions of the characteristics of soil are presented in **Appendix III.**

3.2. Details of Experiment

3.2.1. Planting materials

The seeds of variety BARI Misti morich-2 was collected from Bangladesh Agricultural Research Institute (BARI), Joydepur,and F_1 Hybrid Sweet pepper (Lalima), Peperone Yolo Wonderwere collected from Siddik Bazar, Gulistan, Dhaka.

3.2.2. Seed treatment

Seeds were treated by Vitavax 200 @ 5 g/1 kg seeds to protect various seed borne diseases like leaf spot, blight, anthracnose etc.

3.2.3. Raising of seedlings on seedbed

Sweet pepper seedlings were raised in the seedbed of 3 m × 1 m size. The soil was well prepared and converted into loose friable condition to obtain good tilth. All weeds, stubbles and dead root were removed. Twenty grams of seeds were sown in two seedbeds. The seeds were sown in the seed bed on 10 October, 2019. Seeds were then covered with finished light soil and shading was provided by polyethylene bags to protect the young seedlings from scorching sunshine and rainfall. Light watering weeding and mulching were done as and when necessary to provide seedlings of a good condition for growth.

3.2.4. Treatment of the experiment

The experiment was conducted to find out the effect of different organic nutrients on growth and yield of sweet pepper. The experiment consisted of two factors.

Factor A: It consisted of four levels of organic nutrients which are mentioned below with alphabetic symbol.

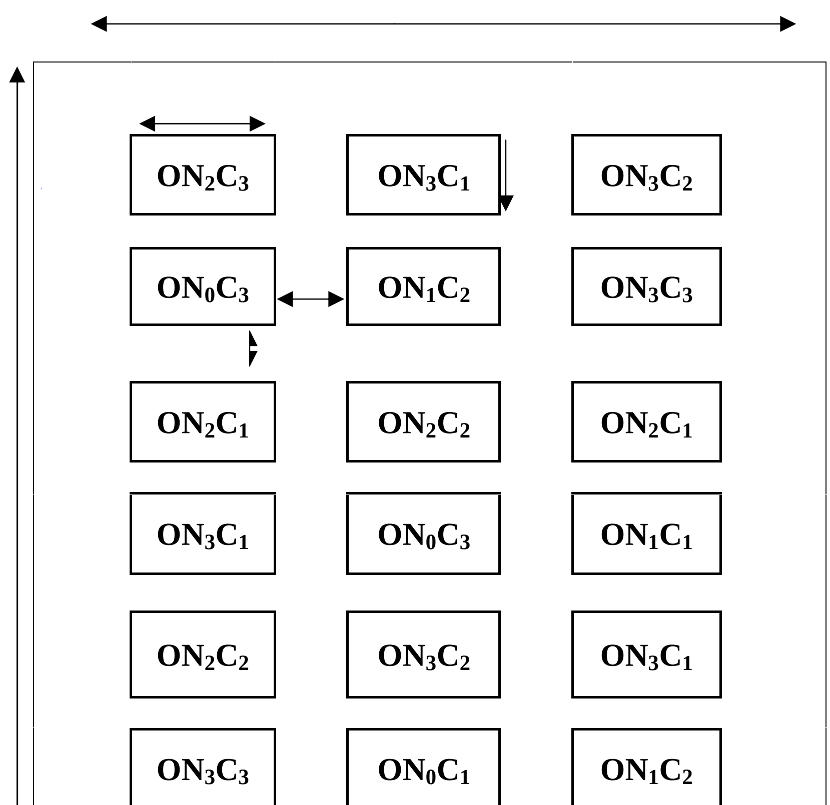
ON_0 : Control (No manure application)
ON_1 : Cowdung (10 t/ha)
ON_3 : Kitchen compost (7 t/ha)

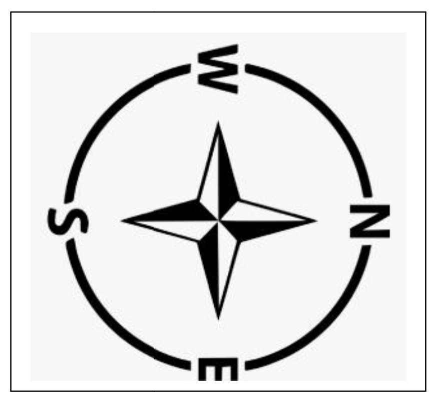
ON_4 : Vermicompost (5 t/ha)

Factor B: It included three different colored sweet pepper which are mentioned below with alphabetic symbol.

C_1: Peperone Yolo Wonder
C_2: F_1 Hybrid Sweet Pepper (Lalima)
C_3: BARI Mistimorich 2

This experiment was designed with (4 x 3) treatments i.e. 12 treatment combinations. So, the 12 treatments are presented as- ON_0C_1, ON_0C_2, ON_0C_3, ON_1C_1, ON_1C_2, ON_1C_3, ON_2C_1, ON_2C_2, ON_2C_3, ON_3C_1, ON_3C_2, ON_3C_3.





s

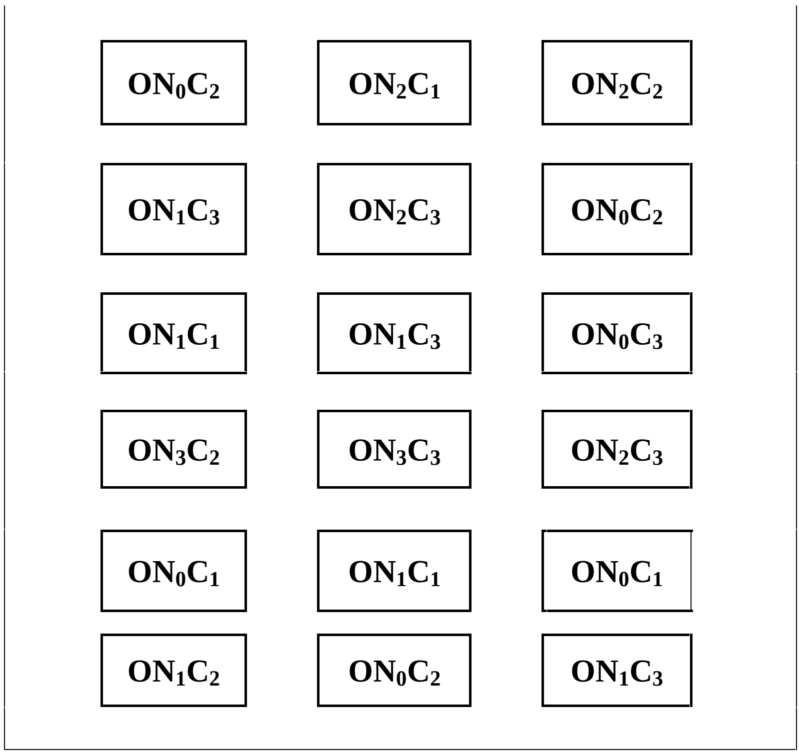


Fig. 1. Field layout of the experiment

3.2.5. Experimental design and layout

The two factor experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. Each block consisted of 12 plots where 12 treatments combination of cow dung, kitchen compost and vermicompost were assigned randomly as per design of the experiment. There were 36 unit plots altogether in the experiment. The size of the plot was 1.8 m × 1 m. Space inbetween replications was 0.50 m and plot to plot 0.50 m. Seedlings were transplanted in the plots with 60 cm × 50 cm spacing.

3.2.6. Preparation of the experimental field

The selected plot was fallow at the time of period of land preparation. The land was opened on October, 2019 with the help of the power tiller and then it was kept open to sun for seven days prior to further ploughing, cross ploughing followed by laddering. The weeds and stubbles were removed after each laddering. Simultaneously the clods were broken and the soil was made into good tilth for transplanting.

3.2.7. Application of manure and fertilizers

Well decomposed 2/3 portion of cowdung, kitchen compost and vermicompost was applied as a basal dose to the plots as per treatment and incorporated to the soil during final land preparation. The rest of 1/3 portion of organic nutrients were applied after 35 DAT.

3.2.8. Composition of nutrients

The composition of cow dung, kitchen compost and vermicompost is shown as tabular form in table 1.

Table 1: Composition of cow dung, kitchen compost and vermicompost (Data from soil analysis report from Soil Resource Development Institute, 2019).

Manure	Nutrients		
	N (%)	P (%)	K (%)
Cow dung	0.85	0.12	1.49
Kitchen compost	1.8	0.3	2.0
Vermicompost	2.0	1.7	2.4

3.3. Growing of the crops

3.3.1. Transplanting of the seedlings in the experimental field

Thirty days old healthy and uniform sized seedlings were transplanted in the experimental plots on 10 November, 2019. The seedbed was watered one hour before uprooting the seedlings to minimize the damage to the roots of the seedlings. Transplanting was done in the afternoon. During transplanting of seedling, 60 cm × 50 cm spacing were followed. 6 plants were transplanted in each unit plot. The seedlings were watered immediately after transplanting. To protect from scorching sunshine and unexpected rain, banana leaf sheath pieces were used over the transplanted seedlings. Shading and watering were continued until the seedlings were well established and it required for 6 days. A number of treated seedlings were planted on the border of the experimental plots for gap filling.

3.3.2. Intercultural operations

Various intercultural operations viz. irrigation and drainage, gap filling, weeding, earthing up, stacking, and pruning were accomplished for better growth and development of seedlings.

3.3.2.1. Irrigation and drainage

Light irrigation was provided with a watering cane to the plots once immediately after transplanting and in every alternate day in the evening up to 1 week. Further irrigation was applied as and when needed. Stagnant water was effectively drained out at the time of excess irrigation.

3.3.2.2. Gap filling

Very few seedlings were damaged after transplanting and such seedling were replaced by new seedlings from the same stock planted earlier on the border of the experimental plots. The seedlings were transplanted with a mass of root attached with soil ball to avoid transplanting shock.

3.3.2.3. Weeding

Weeding was done to keep the plots free from weeds, easy aeration of soil, which ultimately ensured better growth and development. The weeding was done at 10 days interval after transplanting to keep the plots free from weeds. Breaking the crust of the soil was done when needed.

3.3.2.4. Earthing up

Earthing up was done on both sides of rows after 60 days of transplanting, using the soil from the space between the rows due to erosion of soil by rainfall.

3.3.2.5. Staking

For supporting, stacking was done 30 days after transplanting(DAT)to maintain upright growing of sweet pepper.

3.3.2.6. Pruning

40 days after planting pruning was done for the removal of unnecessary flowering and branching. Then it was also done when necessary.

3.3.2.7. Control of pest and disease

Insect attack was serious problem at the time of establishment of the seedling. Mole cricket, field cricket and cut warm attacked the young transplanted seedlings. To control the pest and disease three types of controlling measure was applied. These are:

1. **Mechanical Control**: Mosquito net was applied in whole field to protect the crop from caterpillars, moths, flies etc. Yellow sticky trap was used to prevent the small insect such as, aphid, mites, thrips, leafhopper, and whitefly.

2. **Organic Control:** Neem cake was applied 4-5 days before transplanting for controlling the soil born insects such as nematodes, field cricket and mole cricket. Cut worms were controlled both mechanically and spraying by homemade organic pesticide such as soap spry (mixture of regular soap and

water). Some of the plants were attacked by aphids and were controlled by spraying neem soap. Few plants were infected by Alternaria leaf spot disease caused by *Alternariabrasicae.* To prevent the spread of disease marigold leaf extract was sprayed in the field at the rate of 1.35 kg per 450 liters of water.

3. **Biological Control:** Pheromone trap was used to capture the moths and fruit fly. Neembecidine was used to control the leaf curl disease of capsicum caused by aphid.

3.3.2.8. Harvesting

Harvesting of fruits was started at 80 DAT and continued up to final harvest. Harvesting was done usually by hand picking.

3.4. Data collection

Data were recorded from each plot. Four plants were randomly selected from each unit plot for the collection of data. Data were collected in respect of the following parameters.

(a) (b) (c) (d)

(e) (f) (g) (h) (i)

Plate 1. Photograph showing **1a.** Seedbed preparation; **1b.** Planting materials; **1c.** Transplanting seedling in the main field; **1d.** Fertilization in the main field; **1e.** Applying pesticide in the main field;**1f**. Staking; **1g.** Flower initiation; **1h.** Pest control (applying mosquito net and yellow sticky trap); **1i**. Harvesting

3.4.1. Plant height

Plant height was measured in centimeter from the ground level to tip of the longest stem and mean value was calculated. Plant height was recorded at 25, 50, 75 and 100 (at final harvest).

3.4.2. Number of leaves per plant

The total number of leaves per plant was counted. Data were recorded as the average of four plants selected at random starting from 25 days after planting (DAP) interval and continued until harvest and their average value was calculated.

3.4.3. Number of branches per plant

The number of branches per plant was manually counted at 25 days after transplanting from tagged plants. The average of four plants were computed and expressed in average number of branches per plant.

3.4.4. Canopy of plant

The canopy of plant was manually measured at 25 days after transplanting from tagged plants. The canopy of plant was measured by using meter scale. The average of four plants were computed and expressed in average canopy of plant.

3.4.5. Days to flower initiation

The data were recorded from the date of transplanting to first flowering of plant at each plot.

3.4.6. Number of flowers per plant

The number of flowers per plant was counted at 50 days after transplanting from the 4 sample plants. The final average value of number of flowers was calculated from 4 averages from five plants.

3.4.7. Number of fruits per plant

The total number of fruits produced in a plant was counted and recorded

3.4.8. Length of fruit

The length of all the marketable fruits were measured with a slide calipers from the neck of the fruits to the bottom of the fruits from each plot. Fruit weight above 50 g was considered as marketable fruits.

3.4.9. Diameter of fruit

Diameter of all the marketable fruits from each plot was measured at the middle portion with a slide caliper.

3.4.10. Weight of individual fruit (g)

Individual fruit weight was measured for the average fruit weight of all the marketable fruits under each plot.

3.4.11. Weight of fruit per plant (g)

Weight of per plant fruit was recorded in gram (g) by measuring the weight of all fruits per plant and the marketable fruits per plant.

3.5. Yield per plant(kg)

Total fruit weight of each plant was obtained by addition of individual fruit weight and mean fruit weight was acquired from division of total fruit weight to total number of fruits.

3.6. Brix (%)

Brix was measured by Refractometer (Hanna Instrument, HI96801, Romania) at room temperature. Firstly, selected fruit was blended and juice extract was collected to determine brix and expressed as percentwise

3.7. Vitamin C

Ascorbic acid was quantitatively determined according to 2, 6 dichlorophenolindophenol-dye method as described by Jones and Hughes (1983) with slight modifications. The ascorbic acid in 10 g of fresh sample was extracted by grinding with a small amount of acid-washed quartz sand and 3% meta-phosphoric acid (v/v). The extract volume was made up to 100 ml, mixed and centrifuged at 3000 g for 15 min at room temperature. Ten milli litres were titrated against standard 2, 6-dichlorophenolindophenol dye, which was already standardized against standard ascorbic acid. Results were expressed on mg /100g Fw.

3.8. Antioxidant activity (%)

Methanol extracts of freeze-dried fruits were prepared for the determination of antioxidantactivity. Weighed pepper fruit samples (5 g) were placed in a glass beaker and homogenized with 50 mL of methanol at 24◦C overnight. The homogenate was filtered and then centrifuged at 6000 rpm for 15 min. Free radical scavenging activity of the samples was determined using the 2,2,-diphenyl-2-picrylhydrazyl (DPPH) method (Turkmen, *et al*., 2005). An aliquot of 2 ml of 0.15 mM DPPH radical in methanol was added to a test tube with 1 ml of the sample extract. The reaction mixture was vortex mixed for 30 s and left to stand at room temperature in the dark for 20 min. The absorbance was measured at 517nm, using a spectrophotometer (Bio Quest, CE 2502, UK). The antioxidant activity was calculated using the following equation: Antioxidant activity (%) = 1 - A Sample (517 nm)/A Control (517 nm) ×100.

3.9. Total anthocyanin measurement

The pigment (anthocyanin, at 500 and 900nm) of the fruit was investigated with a UV-VIS spectrophotometer (Hanna Instrument, HI96801, Romania). Three equivalent aged fruits from each tunnel were collected early in the morning. Each sample was extracted with 15 ml of methanol: HCl (99:1) and placed in a vial. Then the procedure was followed according to (Tsormpatsidis *et al*. 2008) and then the results were expressed as mg $100g^{-1}$ fresh weight (FW). The absorbance measurement was done within 20-50 min of preparation.

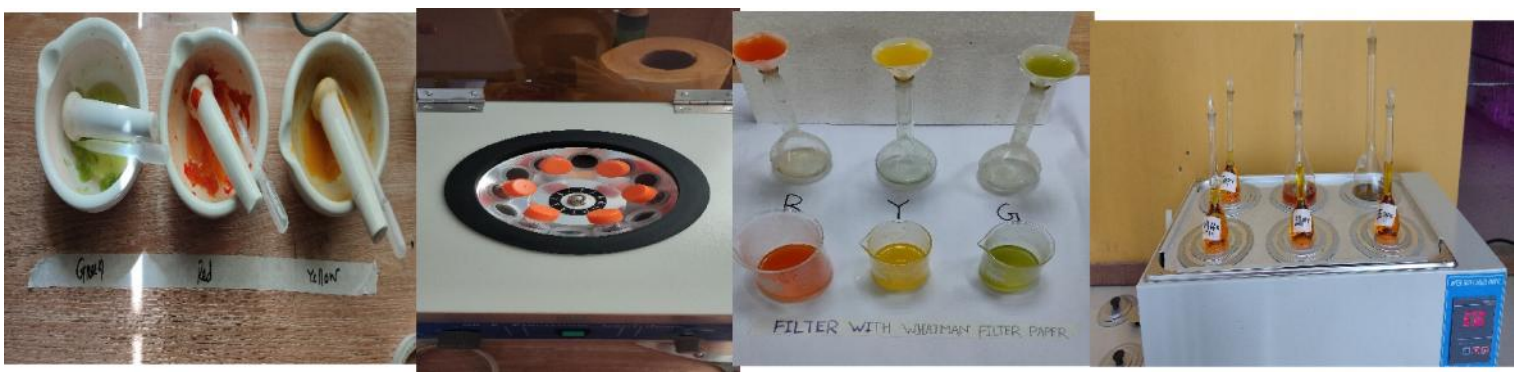
The anthocyanin pigment concentration expressed as cyaniding-3-glucoside equivalent, as follows:

Anthocyanin pigment (cyaniding-3-glucoside equivalents, mg·100 g^{-1} FW)

$$= \frac{A \times MW \times DF \times 1000}{\varepsilon \times 1}$$

Where, A = (A500nm- A900nm) pH 1.0 – (A500nm – A900nm) pH 4.5; MW (molecular weight) = 449.2 g.mol-1for cyaniding-3-glucoside; DF = dilution factor; 1 = path length in cm;   = 26, 900 molar extinction coefficient, in L × mol 1× cm-1, for cyaniding-3-glucoside and 1000 = factor for conversion from g to mg.

(a) (b) (c) (d)



(e) (f) (g) (h)

Plate 2. Photograph showing **2a.** Measurement of fruit length using meter scale in cm; **2b.** Measurement of fruit diameter using slide calipers; **2c.** Fruit weight determination using digital weight machine; **2d.** Brix % identification by using brix meter; **2e.** Measurement

of anthocyanin by using mortar and pestle; **2f.** Electrical centrifuge using for antioxidant; **2g.** Whateman filterpaper use for filtering sample; **2h**. Water bath use for preparing sample in vitamin c

3.10. Statistical analysis

The data obtained for different parameters were statistically analyzed to find out the significance difference of spacing and nutrient sources on growth and yield contributing characters of stevia. The mean values of all the attributes studied were calculated and analysis of variance was performed by the F (Variance Ratio) test. The significance of the difference among the treatment combinations was estimated by the Least Significant Difference Test (LSD) at 5% level of probability (Gomez and Gomez, 1989).

3.11. Economic analyses

The cost of production was calculated to find out the most economic combination of variety and growth hormone. All input cost like the cost for land lease and interests on running capital were computing in the calculation. The interests were calculated @ 13% in simple rate. The market price of bell pepper was considered for estimating the return. Analyses were done according to the procedure of Alam *et al*. (1989). The benefit cost ratio (BCR) was calculated as follows:

The benefit cost ratio (BCR) was calculated by the following formula.

$$\textbf{Benefit cost ratio (BCR)} = \frac{\textbf{Gross return (Tk/ha)}}{\textbf{Total cost of production}}$$

CHAPTER IV

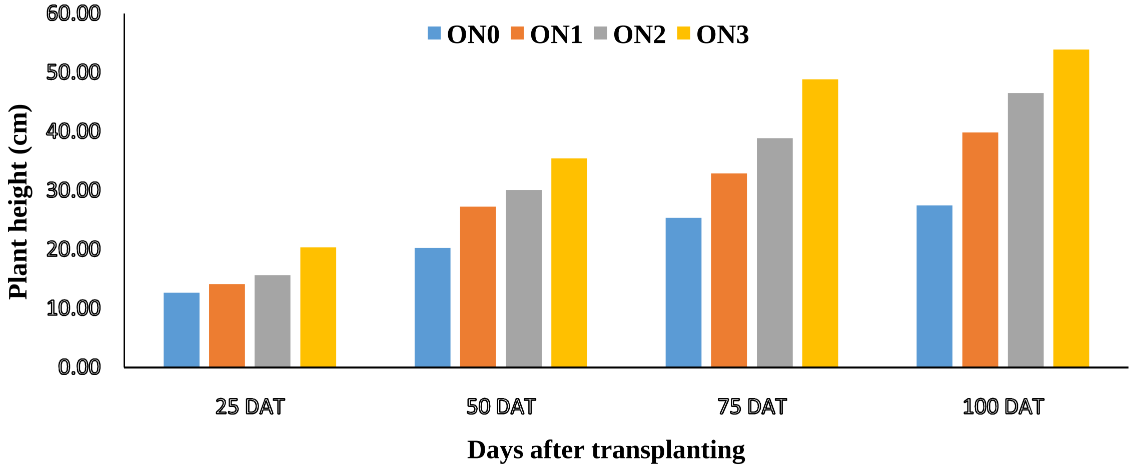
RESULTS AND DISCUSSION

The experiment was carried out to find out the effect of different organic manures and varieties on the growth and yield of sweet pepper. Data on different growth parameters and yield of sweet pepper plant were recorded and the analysis of variance (ANOVA) of the data on different growth parameters and yield of sweet pepper are presented in Appendix (IV-IX). The results have been presented and discussed and the interpretations are given under the following headings:

4.1. Plant height (cm)

4.1.1. Effect of different types of organic nutrients on plant height (cm)

In the experiment plant height of sweet pepper showed significant variation at 25, 50, 75 and 100 DAT (Appendix IV) due to the application of different typesof organicnutrients. At 25 DAT, the longest plant (20.33 cm) was recorded from ON_3 (vermicompost) whereas the shortest (12.62 cm) from ON_0(Control). At 50 DAT, the longest plant was observed from ON_3 (35.44 cm) while the shortest from ON_0 (20.22 cm). At 75 DAT, the longest plant was obtained from $ON_{3(}$48.82 cm) and the shortest was found from ON_0(25.33 cm). At 100 DAT, the longest plant was found from ON_3 (53.88 cm) and the shortest from ON_0(27.44 cm) (Fig. 2). Data revealed that different types of organic nutrient management showed different plant height. Vermicompost showed highest plant height than other management due to release of higher amount of N, P and K. Abdulbaki*et al*. (2019) reported that vermicompost produced the highest plant of 22.37 cm.

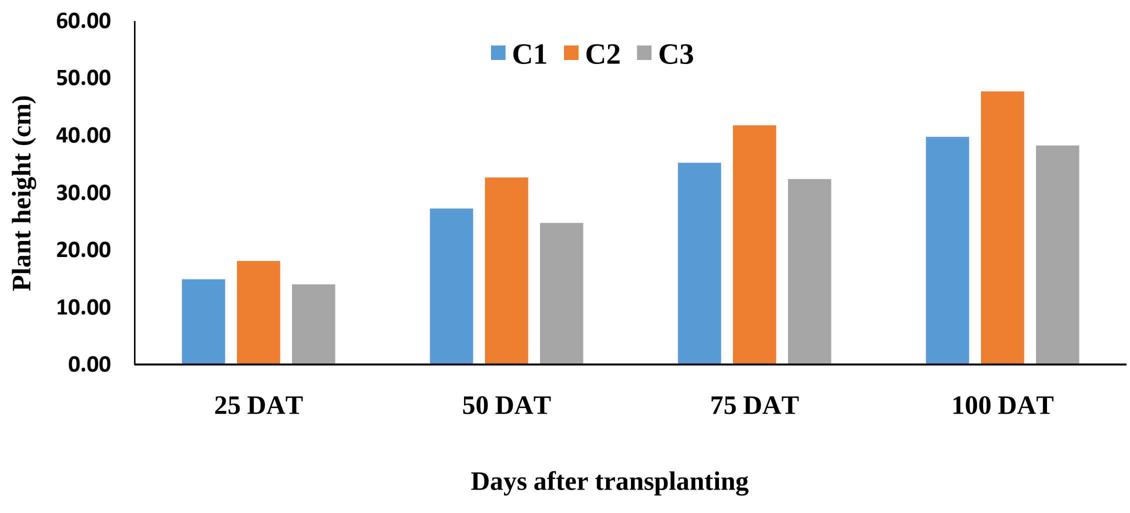


ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Figure 2: Effect of different organic nutrients on plant height (cm) of sweet pepper at different DAT

4.1.2. Effect of varieties on plant height (cm)

Significant variation was recorded on plant height of sweet pepper due to different varieties of fruit at 25, 50, 75, and 100 DAT (Appendix IV). The longest plant (18.09 cm) was obtained from C_2 (Lalima) while the shortest (14.02 cm) from C_3(BARIMistimorich 2) at 25 DAT. At 50 DAT, the longest plant (32.71 cm) was obtained from C_2 (Lalima) while the shortest (24.76 cm) from C_3 (BARIMistimorich 2). The longest plant (41.79 cm) was obtained from C_2 (Lalima) while the shortest (32.38 cm) from C_3 (BARIMistimorich 2) at 75 DAT. At 100 DAT, the longest plant (47.70 cm) was obtained from C_2 (Lalima) while the shortest (38.29 cm) from C_3 (BARIMistimorich 2). Data revealed that different types of fruit showed different plant height (Figure 3).In an experiment,Sharma *et al*. (2004) reported that capsicum cv. California Wonder produced longest plant of 56 cm.



C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 3: Effect of varieties on plant height (cm) of sweet pepper at different DAT

4.1.3. Combined effect of organic nutrientsand varieties on plant height (cm)

Combined effect of organic nutrients and fruit varieties showed significant variation in terms of plant height of sweet pepper at 25, 50, 75 and 100 DAT (Appendix IV). The longest plant (24.66 cm) was found from $ON_3C_2$was similar to (17.66, 18.50, 17.83 cm) from ON_2C_2, ON_3C_1 and ON_3C_3while the shortest plant (11.00 cm) was recorded from ON_0C_3which was similar to ON_0C_1(12.16 cm) at 25 DAT. The longest plant (42.83, 57.61, 62.96 cm) was observed from ON_3C_2 and the shortest (18.00, 24.00, 26.00cm) plant was observed fromON_0C_3at 50, 75 and 100 days respectively. So, data showed that combination of ON_3C_2 result the tallest plant due to optimum fertilization and red colored sweet pepper (Table 2). Hasanuzzaman *et al*. (2007) reported that, due to organic manure treatments significant variation exists among the varieties in respect of morphological characters.

Table 2: Combined effect of different organic nutrients and varieties on plant height (cm) at different days after transplanting (DAT) of sweet pepper

Treatment Combinations	Plant height (cm) at different days after transplanting (DAT)			
	25DAT	**50DAT**	**75DAT**	**100DAT**
ON_0C_1	12.16 fg	20.00 h	25.00 h	27.00 h
ON_0C_2	14.68 cd	22.66 g	27.00 g	29.33 g
ON_0C_3	11.00 g	18.00 i	24.00 h	26.00 h
ON_1C_1	14.00 de	27.16 e	33.15 e	39.33 f
ON_1C_2	15.33 c	29.33 d	35.18 d	42.18 e
ON_1C_3	13.00 ef	25.16 f	30.33 f	38.00 f
ON_2C_1	15.00 cd	29.00 d	36.00 d	42.00 e
ON_2C_2	17.66 b	36.00 b	47.37 b	56.33 b
ON_2C_3	14.25 cde	25.22 f	33.16 e	41.16 e
ON_3C_1	18.50 b	32.83 c	46.83 b	50.67 c
ON_3C_2	24.66 a	42.83 a	57.61 a	62.96 a
ON_3C_3	17.83 b	30.66 d	42.00 c	48.00 d
CV%	4.88	3.53	2.51	2.23
LSD (0.05)	1.3	1.7	1.55	1.6

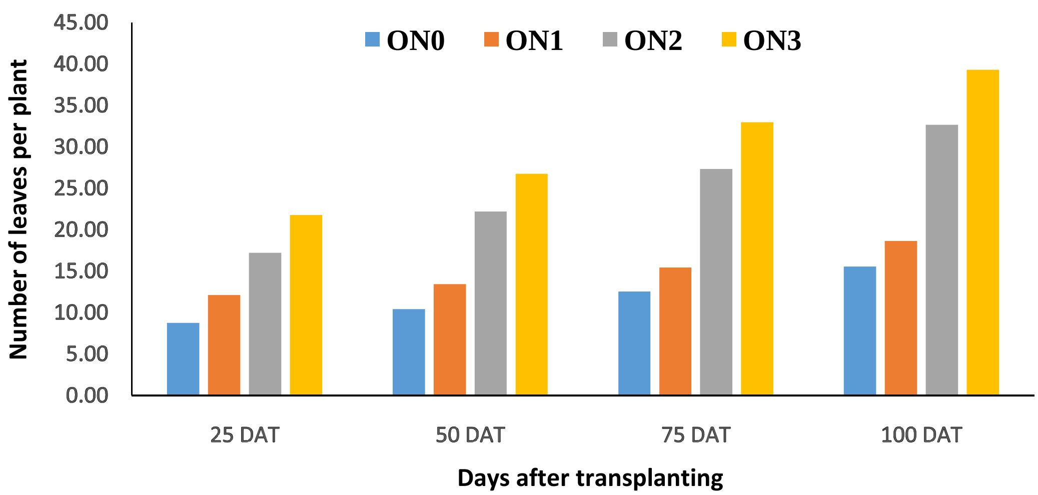
In a column means having similar letter (s) are statistically similar and those having dissimilar letter(s)
differ significantly as per 5% level of significance.

ON_0 : Control (No manure application)C_1: Peperone Yolo Wonder
ON_1 : Cowdung C_2: F1 Hybrid Sweet Pepper (Lalima)
ON_3 : Poultry manure C_3: BARI Mistimorich 2
ON_4 : Vermicompost

4.2. Number of leaves per plant

4.2.1. Effect of different organic nutrients on number of leaves per plant

Significant variation was found on number of leaves per plant of sweet pepper at 25, 50, 75 and 100 DAT due to application of different organic nutrients (Appendix IV). At 25 DAT, the maximum number of leaves per plant (21.78) was found from ON_3 (vermicompost) and the minimum number (8.78) from ON_0(Control). The maximum number of leaves per plant was recorded (26.78, 33.00, 39.33) from ON_3 (vermicompost) at 50 DAT, 75 DAT and 100 DAT. while the minimum number (10.44, 12.56, 15.56) recorded from ON_0(Control) at 50 DAT, 75 DAT and 100 DAT. It was observed that the number of leaves was higher in plants due to applying vermicompost and lower in control (no fertilizer) (Figure 4). Hasanuzzaman *et al.* (2007) reported that applying vermicompost produced the highest leaves (33.37).

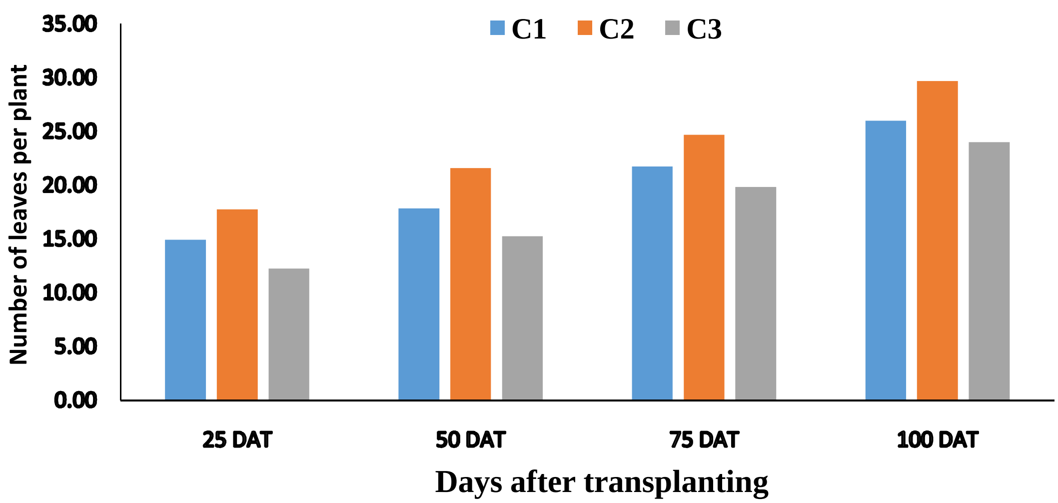


ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Figure 4: Effect of different organic nutrients on number of leaves per plant of sweet pepper at different DAT

4.2.2. Effect of varieties on number of leaves per plant

Significant variation was found on number of leaves per plant of sweet pepper at 25, 50, 75, and 100 DAT due to different fruit varieties (Appendix IV). At 25 DAT, the maximum number of leaves per plant (17.25) was found from C_2 (Lalima) whereas the minimum number (12.25) from C_3 (BARI Mistimorich 2). At 50 DAT the maximum number of leaves per plant was recorded (21.58) from C_2 (Lalima) while the minimum number (15.25) from C_3 (BARI Mistimorich 2). At 75 DAT, the maximum number of leaves per plant was observed (24.67) from C_2 (Lalima) and the minimum number (19.83) from C_3 (BARI Mistimorich 2). At 100 DAT, the maximum number of leaves per plant was obtained (29.67) from C_2 (Lalima) whereas the minimum number (24.00) from C_3 (BARI Mistimorich 2). So the ultimate result was C_2 (Lalima) gave the maximum number of leaves (Figure 5). Sharma *et al*. (2004) reported that capsicum cv. California Wonder under field condition maximum number of leaves (55.76) compared to open net house condition.



C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 5: Effect of varieties on number of leaves per plant of sweet pepper at different DAT

4.2.3. Combined effect of different organic nutrients and varieties on number of leaves per plant of sweet pepper

Combined effect of different organic nutrients and fruit varieties showed statistically significant variation in terms of number of leaves per plant of sweet pepper at 25, 50, 75 and 100 DAT (Appendix IV). At 25 DAT maximum number of leaves per plant was (25.00) from ON_3C_2 and the minimum number of leaves per plant (6.66) was obtained from ON_0C_3.The maximum number of leaves per plant was (32.00, 36.00, 42.00) from $ON_3C_2$and the minimum number of leaves per plant (8.66, 11.00, 13.00) was obtained fromON_0C_3 at 50 DAT, 75 DAT and 100 DAT. Akande *et al.* (2018) investigated the effect of organic manure on growth and yield of capsicum and had significant effect on varieties (Table 3).

Table 3: Combined effect of different organic nutrients and varieties on number of leaves per plant at different days after transplanting (DAT) of sweet pepper

Treatment Combinations	Number of leaves per plant at different days after transplanting			
	25 DAT	50 DAT	75 DAT	100 DAT
ON_0C_1	8.66 j	9.66 i	12.00 i	15.00 k
ON_0C_2	11.00 h	13.00 g	14.66 g	18.66 h
ON_0C_3	6.66 k	8.66 j	11.00 j	13.00 l
ON_1C_1	12.00 g	13.00 g	15.00 g	18.00 i
ON_1C_2	14.33 f	16.33 f	18.00 f	22.00 g
ON_1C_3	10.00 i	11.00 h	13.33 h	16.00 j
ON_2C_1	17.00 e	22.66 d	27.00 d	32.00 e
ON_2C_2	20.66 c	25.00 c	30.00 c	36.00 d
ON_2C_3	14.00 f	19.00 e	25.00 e	30.00 f
ON_3C_1	22.00 b	26.00 b	33.00 b	39.00 b
ON_3C_2	25.00 a	32.00 a	36.00 a	42.00 a
ON_3C_3	18.33 d	22.33 d	30.00 c	37.00 c
CV%	2.58	2.12	1.11	0.63
LSD (0.05)	0.65	0.65	0.41	0.28

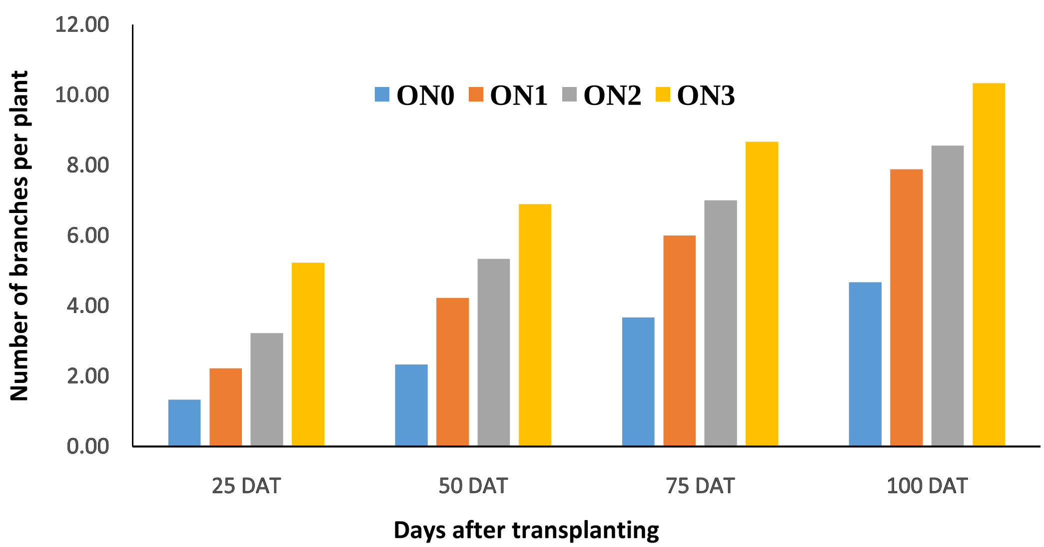
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

ON_0 : Control (No manure application) C_1: Peperone Yolo Wonder
ON_1 : Cowdung C_2: F1 Hybrid Sweet Pepper (Lalima)
ON_3 : Poultry manure C_3: BARI Mistimorich 2
ON_4 : Vermicompost

4.3. Number of branches per plant

4.3.1. Effect of different organic nutrients on number of branches per plant

In the experiment, different organic nutrients showed significant differences for number of branches per plant of sweet pepper at 25, 50, 75 and 100 DAT (Appendix V). At 25, 50, 75 and 100 DAT, the maximum number of branches per plant (5.22, 6.89, 8.67 and 10.33 cm, respectively) was recorded from ON_3 (Vermicompost) which was statistically similar (3.22, 5.33, 7.00 and 8.56 cm, respectively) to ON_2(Kitchen compost) while the minimum number (1.33, 2.33, 3.67 and 4.67 cm, respectively) was found from ON_0(Control) (Figure 6).Sharma *et al.* (2017) also reported that the sweet pepper plants under treatment (vermi compost: bone meal - 75:25) had the maximum number of branches. Similar trend was also found by Singh *et al*. (2006).

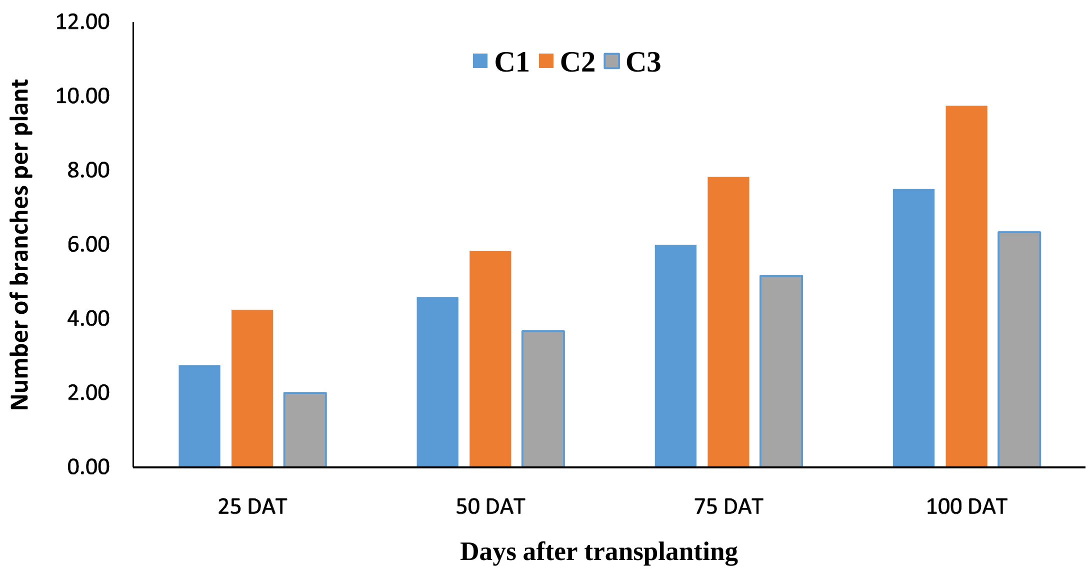


ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Figure 6: Effect of different organic nutrients on number of branches per plant of sweet pepper at different DAT

4.3.2. Effect of different varieties on number of branches per plant

Significant variation was recorded for different varieties of sweet pepper in terms of number of branches per plant at 25, 50, 75 and 100 DAT (Appendix V). At 25, 50, 75 and 100 DAT, the maximum number of branches per plant (4.25, 5.83, 7.83 and 9.75 cm) was observed from C_2 (Lalima), while the minimum number (2.00, 3.67, 5.17 and 6.33 cm) was found from C_3 (Mistimorich 2). Management practices influence the number of branches per plant but variety itself manipulated the number of branches per plant (Figure 7). Sharma *et al*. (2004) reported that capsicum cv. California Wonder under open field condition produced maximum number of branches (5.86) compared to shade net house.



C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 7: Effect of varieties on number of branches per plant of sweet pepper at different DAT

4.3.3. Combined effect of different organic nutrients and fruit varieties on Number of branches per plant

In the experiment, interaction effect of fruit varieties and different organic nutrients showed statistically significant variation in terms of number of branches per plant of sweet pepper at 25, 50, 75 and 100 DAT (Appendix V). The maximum number of branches per plant (6.66, 7.66, 10.33, and 13.00 cm) was obtained from ON_3C_2 at 25, 50, 75 and 100 DAT, respectively which was followed by with combination treatment of ON_3C_1 at 25, 50 and 100 DAT and ON_2C_2 at 75 DAT. On the other hand, the minimum number of branches per plant (1.00, 1.66, 3.00 and 4.00 cm) was recorded from ON_0C_3 at 25, 50, 75 and 100 DAT, respectively which was similar with combined treatment of ON_0C_1 (Table 4).

Table 4: Combined effect of different organic nutrients and varieties on number of branches per plant at different days after transplanting (DAT) of sweet pepper

Treatment Combinations	Number of branches per plant at different days after planting			
	25 DAT	50 DAT	75 DAT	100 DAT
ON_0C_1	1.00 f	2.33 g	3.66 hi	4.66 fg
ON_0C_2	2.00 e	3.00 f	4.33 gh	5.33 ef
ON_0C_3	1.00 f	1.66 h	3.00 i	4.00 g
ON_1C_1	2.00 e	4.00 e	5.66 e	7.33 cd
ON_1C_2	3.66 c	5.66 c	7.66 c	10.00 b
ON_1C_3	1.00 f	3.00 f	4.66 fg	6.33 de
ON_2C_1	3.00 d	5.00 d	6.66 d	8.33 c
ON_2C_2	4.66 b	7.00 b	9.00 b	10.66 b
ON_2C_3	2.00 e	4.00 e	5.33 ef	6.66 d
ON_3C_1	5.00 b	7.00 b	8.00 c	9.66 b
ON_3C_2	6.66 a	7.66 a	10.33 a	13.00 a
ON_3C_3	4.00 c	6.00 c	7.66 c	8.33 c
CV%	8.7	7.34	7.89	8.69
LSD (0.05)	0.42	0.58	0.84	1.15

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

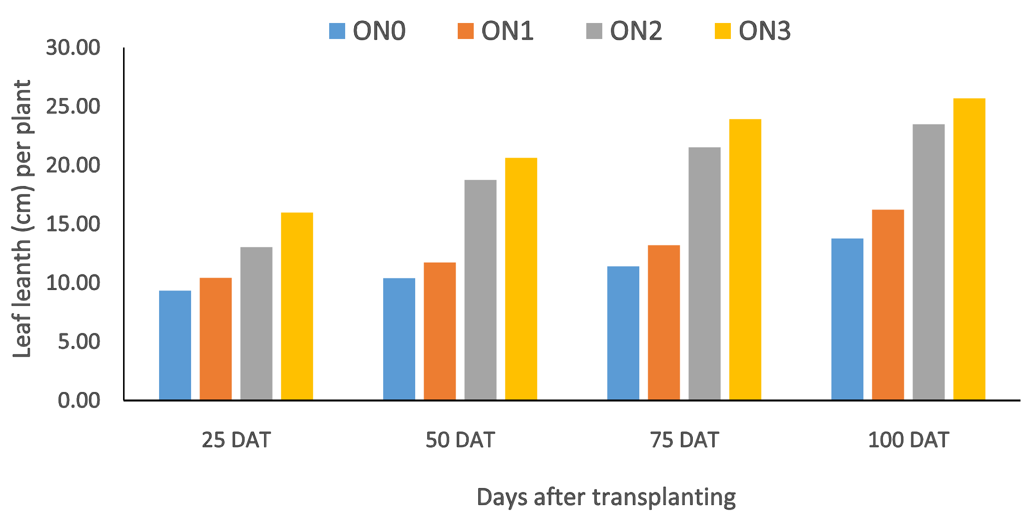
ON_0 : Control (No manure application)
ON_1 : Cowdung
ON_3 : Poultry manure
ON_4 : Vermicompost

C_1: Peperone Yolo Wonder
C_2: F1 Hybrid Sweet Pepper (Lalima)
C_3: BARI Mistimorich 2

4.4. Leaf length

4.4.1. Effect of different organic nutrients on leaf length of leaves

In the experiment, leaf length of sweet pepper varied significantly for different organic nutrients at 25, 50, 75 and 100 DAT (Appendix V). At 25, 50, 75 and 100 DAT, the maximum number of leaf length per plant (16.00, 20.64, 23.94 and 25.71cm, respectively) was obtained from ON_3 (Vermicompost) which was followed by (13.06, 18.76, 21.53 and 23.51cm, respectively) with ON_2 (Kitchen compost) respectively, while the minimum leaf length (9.35, 10.41, 11.42 and 13.78 cm,respectively) was found from ON_0(Control) (Figure 8).

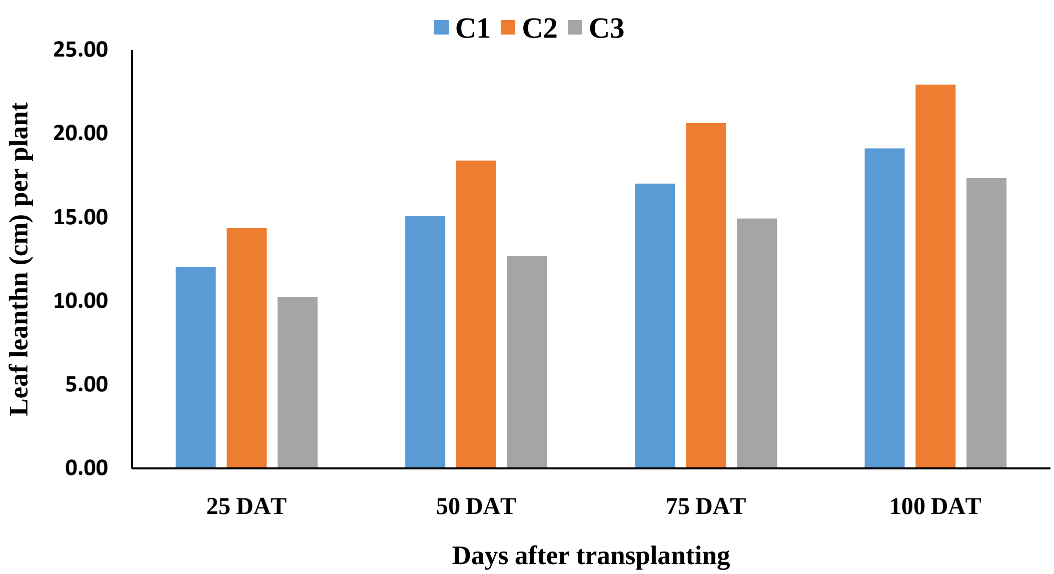


ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Figure 8: Effect of different organic nutrients on leaf length (cm) of sweet pepper at different DAT

4.4.2. Effect of different varieties on leaf length of leaves

Different varieties of sweet pepper showed significant variation for leaf length at 25, 50, 75 and 100 DAT (Appendix V). At 25, 50, 75 and 100 DAT, the highest leaf length (14.35, 18.40, 20.64 and 22.94 cm, respectively) was recorded from C_2 (Lalima), while the minimum number of leaf length per plant (10.25, 12.69, 14.93 and 17.35cm, respectively) was observed from C_3 (BARI Mistimorich 2) (Figure 9). Different varieties produced different leaf length on the basis of their varietal characters and crop variety is one of the important factors.



C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 9: Effect of varieties on leaf length (cm) of sweet pepper at different DAT

4.4.3. Combined effect of different organic nutrients and varieties on leaf length of sweet pepper

Significant variation was observed due to the interaction effect of fruit varieties and different organic nutrients in terms of number of leaf length per plant of sweet pepper at 25, 50, 75 and 100 DAT (Appendix V). The highest number of leaf length per plant (17.66, 24.33, 27.44 and 28.83 cm) was observed from ON_3C_2 at 25, 50, 75 and 100 DAT, respectively which was followed by with ON_3C_1 and ON_2C_2 at 25 DAT and ON_2C_2 at 25, 50, 75 and 100 DAT. On the other hand, the minimum leaf length (7.66, 8.56, 9.34 and 12.00 cm) was recorded from ON_0C_3 at 25, 50, 75 and 100 DAT, respectively which was statistically similar with ON_1C_3 at 25, 50, 75 and 100 DAT (Table 5).

Table 5: Combined effect of different organic nutrients and varieties on leaf length (cm) at different days after transplanting (DAT) of sweet pepper

Treatment Combinations	Length of the leaves at different days after transplanting			
	25 DAT	**50 DAT**	**75 DAT**	**100 DAT**
ON_0C_1	9.16 fg	10.00 i	11.11 i	13.33 h
ON_0C_2	11.22 e	12.66 g	13.81 g	16.00 g
ON_0C_3	7.66 h	8.56 j	9.34 j	12.00 i
ON_1C_1	10.18 ef	11.41 h	12.11 h	15.33 g
ON_1C_2	13.00 cd	14.50 f	16.50 f	19.43 f
ON_1C_3	8.16 gh	9.34 ij	11.05 i	13.91 h
ON_2C_1	12.50 d	18.16 d	21.15 d	22.25 d
ON_2C_2	15.52 b	22.17 b	24.81 b	27.48 b
ON_2C_3	11.16 e	16.00 e	18.63 e	20.70 e
ON_3C_1	16.33 b	20.75 c	23.66 c	25.58 c
ON_3C_2	17.66 a	24.33 a	27.44 a	28.83 a
ON_3C_3	14.00 c	16.83 e	20.71 d	22.70 d
CV%	5.39	3.9	2.6	2.92
LSD (0.05)	1.11	1.02	0.77	0.92

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

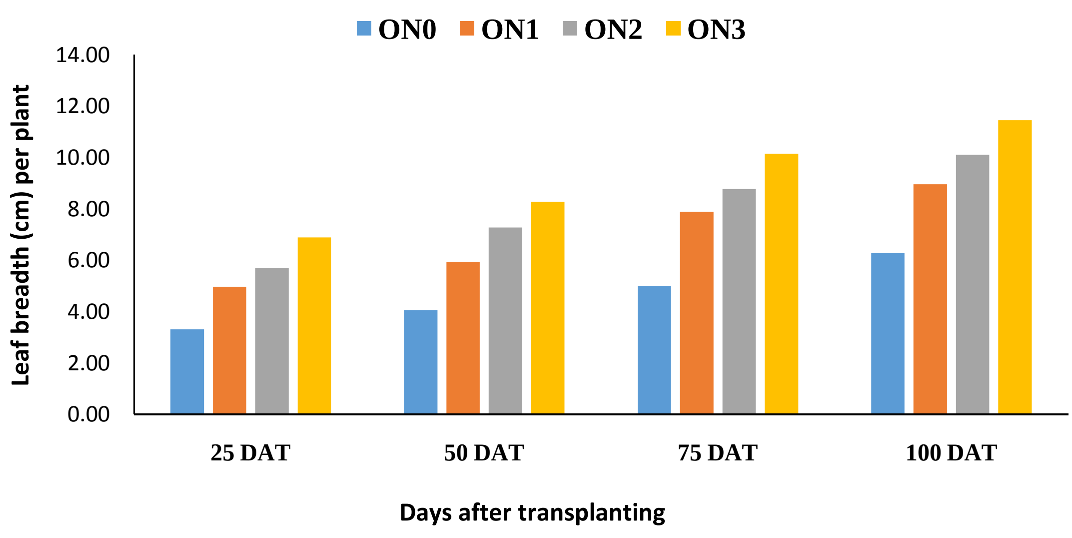
ON_0 : Control (No manure application)
ON_1 : Cowdung
ON_3 : Poultry manure
ON_4 : Vermicompost

C_1: Peperone Yolo Wonder
C_2: F1 Hybrid Sweet Pepper (Lalima)
C_3: BARI Mistimorich 2

4.5. Leaf breadth

4.5.1. Effect of different organic nutrients on leaf breadth

In the experiment, leaf breadth of sweet pepper varied significantly for different organic nutrients at 25, 50, 75 and 100 DAT (Appendix VI). At 25, 50, 75 and 100 DAT, the maximum number of leaf breadth per plant (6.90, 8.28, 10.14 and 11.45cm, respectively) was obtained from ON_3 (Vermicompost) which was statistically similar (5.71, 7.28, 8.78 and 10.11cm, respectively) with ON_2 (Kitchen compost) respectively, while the minimum number of leaf breadth (3.32, 4.07, 5.01 and 6.29 cm, respectively) was found from ON_0(Control) (Figure 10).

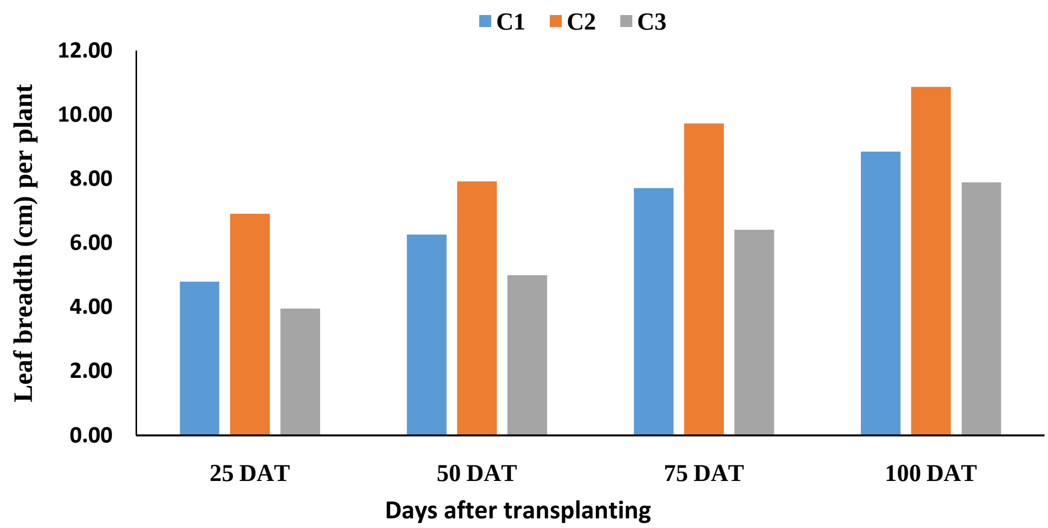


ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Figure 10: Effect of different organic nutrients on leaf breadth (cm) of sweet pepper at different DAT

4.5.2. Effect of different varieties on breadth of leaves

Different varieties of sweet pepper showed significant variation for leaf breath at 25, 50, 75 and 100 DAT (Appendix VI). At 25, 50, 75 and 100 DAT, the highest leaf breadth (6.92, 7.92, 9.74 and 10.87 cm, respectively) was recorded from C_2 (Lalima), while the minimum leaf breadth per plant (3.96, 5.00, 6.42 and 7.89 cm, respectively) was observed from C_3 (BARI Mistimorich 2) (Figure 11). Different varieties produced different leaf breadth on the basis of their varietal characters and crop variety is one of the important factors (Figure 11).



C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 11: Effectof varieties on leaf breadth (cm) of sweet pepper at different DAT

4.5.3. Combined effect of different organic nutrients and varieties on leaf breadth

Significant variation was observed due to the interaction effect of fruit varieties and different organic nutrients in terms of leaf breadth of sweet pepper at 25, 50, 75 and 100 DAT (Appendix VI). The highest leaf breadth (8.83, 10.01, 12.94 and 13.91 cm) was observed from ON_3C_2 at 25, 50, 75 and 100 DAT, respectively which was followed by with ON_2C_2 at 25, 50, 75 and 100 DAT. On the other hand, the minimum leaf breadth (2.70, 3.31, 4.00 and 5.31 cm) was recorded from ON_0C_3 at 25, 50, 75 and 100 DAT, respectively which was followed by withON_0C_1 at 25, 50, 75 and 100 DAT (Table 6).

Table 6: Combined effect of different organic nutrients and varieties on leaf breadth (cm) at different days after transplanting (DAT) of sweet pepper

Treatment Combinations	Leaf Breadth at different days aftertransplanting			
	25 DAT	50 DAT	75 DAT	100 DAT
ON_0C_1	3.08 g	3.89 g	4.78 g	6.00 g
ON_0C_2	4.16 e	5.00 f	6.24 f	7.55 f
ON_0C_3	2.70 h	3.31 h	4.00 h	5.31 h
ON_1C_1	4.25 e	6.00 e	8.00 d	8.89 e
ON_1C_2	6.92 c	7.83 c	9.42 c	10.18 cd
ON_1C_3	3.75 f	4.00 g	6.26 f	7.83 f
ON_2C_1	5.16 d	7.16 d	9.00 c	9.75 d
ON_2C_2	7.75 b	8.83 b	10.33 b	11.81 b
ON_2C_3	4.22 e	5.83 e	7.00 e	8.75 e
ON_3C_1	6.69 c	8.00 c	9.08 c	10.78 c
ON_3C_2	8.83 a	10.01 a	12.94 a	13.91 a
ON_3C_3	5.16 d	6.83 d	8.41 d	9.66 d
CV%	3.74	4.26	3.8	4.18
LSD (0.05)	0.36	0.46	0.54	0.62

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

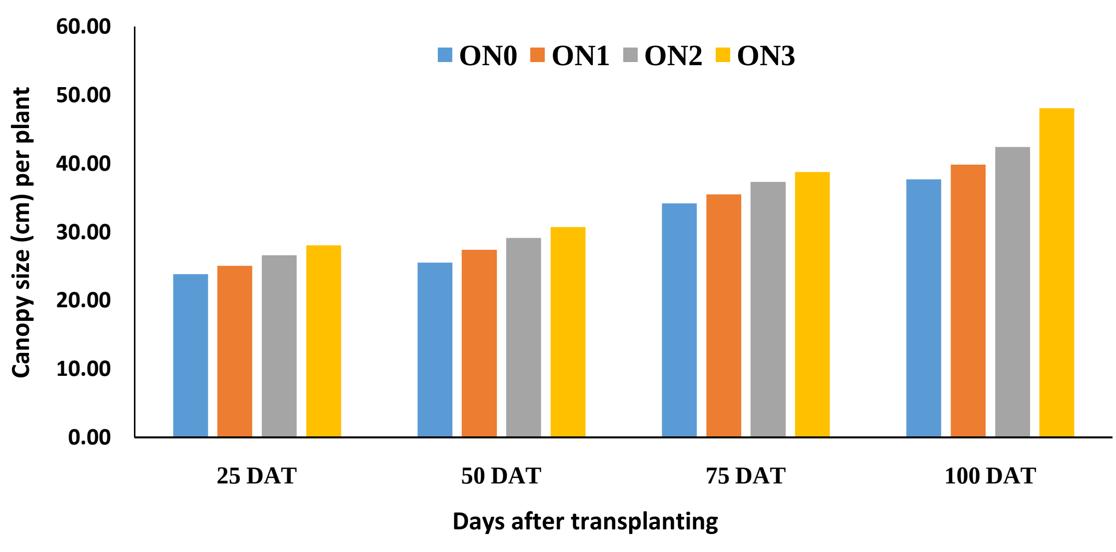
ON_0 : Control (No manure application)
ON_1 : Cowdung
ON_3 : Poultry manure
ON_4 : Vermicompost

C_1: Peperone Yolo Wonder
C_2: F1 Hybrid Sweet Pepper (Lalima)
C_3: BARI Mistimorich 2

4.6. Canopy size

4.6.1. Effect of different organic nutrients on canopy size

In the experiment, canopy size of sweet pepper varied significantly for different organic nutrients at 25, 50, 75 and 100 DAT (Appendix VI). At 25, 50, 75 and 100 DAT, the maximum canopy size (6.90, 8.28, 10.14 and 11.45cm, respectively) was obtained from ON_3 (Vermicompost) which was followed by (5.71, 7.28, 8.78 and 10.11cm, respectively) with ON_2 (Kitchen compost) respectively, while the minimum canopy size (3.32, 4.07, 5.01 and 6.29 cm, respectively) was found from ON_0(Control) (Figure 12).

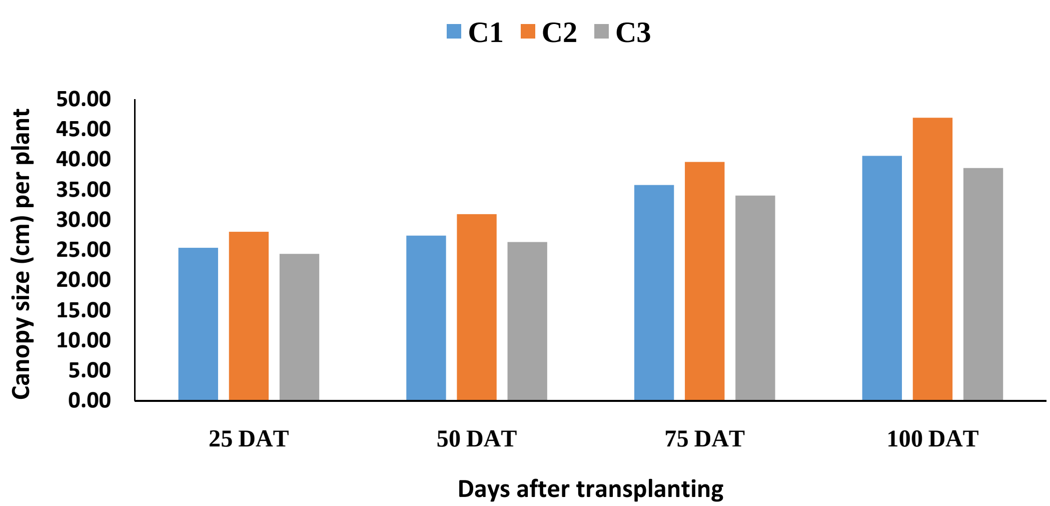


ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Figure 12: Effect of different organic nutrients on canopy size (cm) of sweet pepper at different DAT

4.6.2. Effect of different varieties on canopy size

Different varieties of sweet pepper showed significant variation for canopy size at 25, 50, 75 and 100 DAT (Appendix VI). At 25, 50, 75 and 100 DAT, the highest canopy size (6.92, 7.92, 9.74 and 10.87 cm, respectively) was recorded from C_2 (Lalima), while the minimum canopy size (3.96, 5.00, 6.42 and 7.89 cm, respectively) was observed from C_3 (BARI Mistimorich 2) (Figure 13). Different varieties produced different canopy size on the basis of their varietal characters and crop variety is one of the important factors (Figure 13).



C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 13: Effect of varieties on canopy size (cm) of sweet pepper at different DAT

4.6.3. Combined effect of different organic nutrients and varieties on canopy size

Significant variation was observed due to the interaction effect of varieties and different organic nutrients in terms of canopy size of sweet pepper at 25, 50, 75 and 100 DAT (Appendix VI). The highest canopy size (8.83, 10.01, 12.94 and 13.91 cm) was observed from ON_3C_2 at 25, 50, 75 and 100 DAT, respectively which was followed by with ON_2C_2 at 25, 50, 75 and 100 DAT. On the other hand, the minimum canopy size (2.70, 3.31, 4.00 and 5.31 cm) was recorded from ON_0C_3 at 25, 50, 75 and 100 DAT, respectively which was followed by with ON_0C_1 at 25, 50, 75 and 100 DAT (Table 7).

Table 7: Combined effect of different organic nutrients and varieties on canopy size (cm) at different days after transplanting (DAT) of sweet pepper

Treatment Combinations	Canopy size (cm) at different days after transplanting			
	25 DAT	**50 DAT**	**75 DAT**	**100 DAT**
ON_0C_1	23.30 h	25.16 g	33.36 gh	35.85 k
ON_0C_2	25.65 e	27.16 f	36.70 de	42.75 f
ON_0C_3	22.67 i	24.36 h	32.53 h	34.59 l
ON_1C_1	24.22 g	26.93 f	35.33 f	38.90 h
ON_1C_2	27.20 c	29.66 c	37.56 cd	43.45 e
ON_1C_3	23.85 g	25.65 g	33.65 g	37.32 j
ON_2C_1	26.44 d	28.39 e	36.52 e	39.85 g
ON_2C_2	28.37 b	32.16 b	40.79 b	49.65 b
ON_2C_3	25.09 f	26.96 f	34.66 f	37.89 i
ON_3C_1	27.56 c	29.00 d	37.85 c	47.89 c
ON_3C_2	30.92 a	34.83 a	43.33 a	51.79 a
ON_3C_3	25.78 e	28.35 e	35.19 f	44.63 d
CV%	1.16	1.18	1.44	0.8
LSD (0.05)	0.51	0.6	0.86	0.56

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

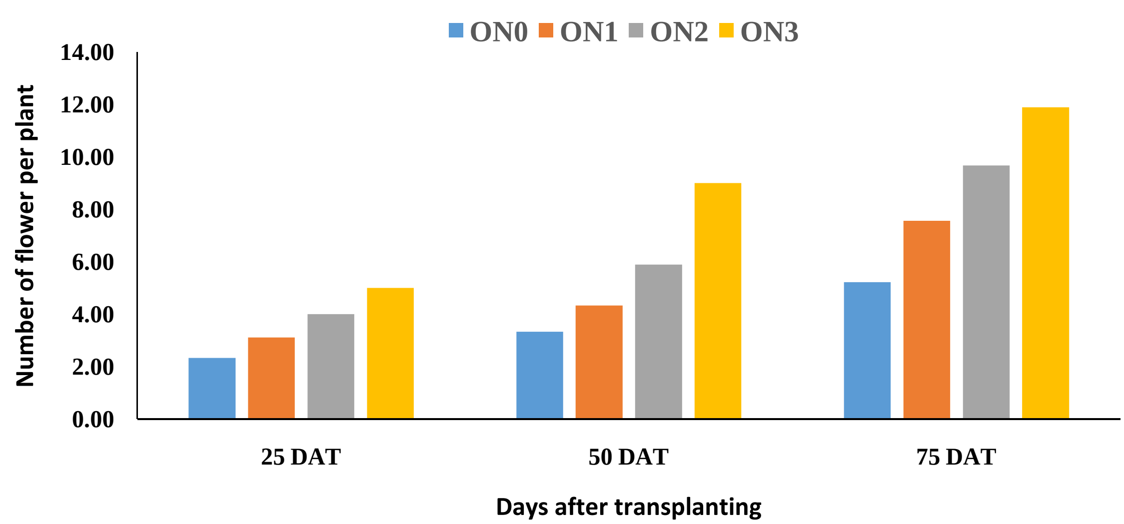
ON_0 : Control (No manure application)
ON_1 : Cowdung
ON_3 : Poultry manure
ON_4 : Vermicompost

C_1: Peperone Yolo Wonder
C_2: F1 Hybrid Sweet Pepper (Lalima)
C_3: BARI Mistimorich 2

4.7. Number of flower

4.7.1. Effect of different organic nutrients on number of flowers

In the experiment, number of flowers of sweet pepper varied significantly for different organic nutrients at 25, 50, 75 and 100 DAT (Appendix VI). At 25, 50, 75 and 100 DAT, the maximum number of flowers (6.90, 8.28, 10.14 and 11.45cm, respectively) was obtained from ON_3 (Vermicompost) which was followed by (5.71, 7.28, 8.78 and 10.11cm, respectively) with ON_2 (Kitchen compost) respectively, while the minimum number of flowers (3.32, 4.07, 5.01 and 6.29 cm, respectively) was found from ON_0(Control) (Figure 14). Chaudhary *et al.*, 2006 reported that organic nutrients vermicompost played an essential role in flower development.

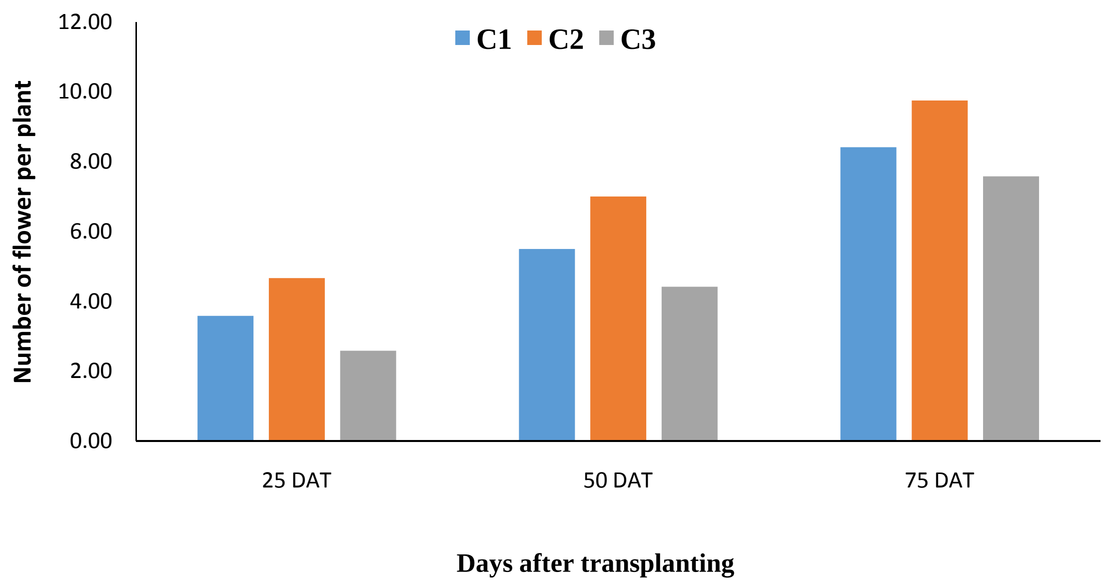


ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Figure 14: Effect of different organic nutrients on number of flowers of sweet pepper at different DAT

4.7.2. Effect of different varieties on number of flowers

Different varieties of sweet pepper showed significant variation for number of flowers per plant at 25, 50 and 75 DAT (Appendix VI). At 25, 50, and 75 DAT the highest number of flowers (4.67, 7.00 and 9.75, respectively) was recorded from C_2 (Lalima), while the minimum number of flowers (2.58, 4.42 and 7.58, respectively) was observed from C_3 (BARI Mistimorich 2) (Figure 15).



C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 15: Effect of varieties on number of flowers of sweet pepper at different DAT

4.7.3. Combined effect of different organic nutrients and varieties on number of flowers

Significant variation was observed due to the interaction effect of varieties and different organic nutrients in terms of number of flowers of sweet pepper at 25, 50, and 75 DAT (Appendix VI). The highest number of flowers (6.00, 10.33 and 13.33) was observed from ON_3C_2 at 25, 50, and 75 DAT, respectively which was followed by with ON_3C_1at 25, 50 and 75 DAT and ON_2C_2 at 25 DAT. On the other hand, the minimum number of flowers(1.33, 2.33 and 4.66) was recorded from ON_0C_3 at 25, 50 and 75 DAT, respectively which was followed by with ON_0C_1 at 25, 50, and 75 DAT (Table 8).

Table 8: Combined effect of different organic nutrients and varieties on number of flowers at different days after transplanting (DAT) of sweet pepper

Treatment Combinations	Number of flowers at different days after transplanting		
	25 DAT	50 DAT	75 DAT
ON_0C_1	2.33 e	3.33 h	5.00 h
ON_0C_2	3.33 d	4.33 fg	6.00 g
ON_0C_3	1.33 f	2.33 i	4.66 h
ON_1C_1	3.00 d	4.00 g	7.33 f
ON_1C_2	4.33 c	6.00 e	9.00 de
ON_1C_3	2.00 e	3.00 h	6.33 g
ON_2C_1	4.00 c	6.00 e	9.66 d
ON_2C_2	5.00 b	7.00 d	10.66 c
ON_2C_3	3.00 d	4.66 f	8.66 e
ON_3C_1	5.00 b	8.66 b	11.66 b
ON_3C_2	6.00 a	10.66 a	13.33 a
ON_3C_3	4.00 c	7.66 c	10.66 c
CV%	7.87	6.11	5.46
LSD (0.05)	0.48	0.54	0.79

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

ON_0 : Control (No manure application) C_1: Peperone Yolo Wonder
ON_1 : Cowdung C_2: F1 Hybrid Sweet Pepper (Lalima)
ON_3 : Poultry manure C_3: BARI Mistimorich 2
ON_4 : Vermicompost

4.8. Fresh yield

4.8.1. Effect of different organic nutrients on number of fruits

Different organic nutrients significantly influenced on number of fruits per plant of sweet pepper (Appendix VII). The highest number of fruits (8.88) was found fromON_3 (Vermicompost) which was closely followed by ON_2 (Kitchen compost)(7.55), while the lowest number (5.00) was recorded from ON_0 control condition (Table 9).

4.8.2. Effect of different varieties on number of fruits

Different varieties of sweet pepper showed significant variation on number of fruits per plant (Appendix VII). The higher number of fruits (8.25) was obtained fromC_2 (Lalima), while the lower number (5.83) was obtained from C_3 (BARI Mistimorich 2)(Table 10).

4.8.3. Combined effect of different organic nutrients and fruit varieties on number of fruits

Significant variation was observed due to the interaction effect of varieties and different organic nutrients in terms of number of fruits (Appendix VII). The highest number of fruits per plant (10.33) was recorded from ON_3C_2 which was followed by to $ON_3C_1$and ON_2C_2 the lowest number (4.00) was observed from ON_0C_3 which was followed by with ON_0C_1(Table 11).

4.8.4. Effect of different organic nutrients on fruit diameter

Different organic nutrients showed significant variation on diameter of fruits (Appendix VII). The maximum diameter of fruit (8.73 cm) was found from ON_3 (Vermicompost) which was followed by (7.58cm) to ON_2 (Kitchen compost) where the minimum diameter (4.54 cm) was observed from ON_0 control condition (Table 9).

4.8.5. Effect of different varieties on fruit diameter

Different varieties of sweet pepper showed significant variation for diameter of fruit (Appendix VII). The maximum fruit diameter(7.56 cm) was recorded from C_2 (Lalima), while the minimum fruit diameter (5.92cm) was found from C_3 (BARI Mistimorich 2) (Table 10).

4.8.6. Combined effect of different organic nutrients and varieties on fruit diameter

Significant variation was observed due to the interaction effect of varieties and different organic nutrientsin terms of diameter of fruit (Appendix VII). The maximum diameter of fruit (9.54 cm) was found from ON_3C_2, while the minimum length (3.45 cm) was observed from ON_0C_3(Table 11)

4.8.7. Effect of different organic nutrients on fruit length

In the experiment, significant variation was recorded for length of fruit of sweet pepper for different organic nutrients (Appendix VII). The maximum length of fruit (11.51cm) was found from ON_3 (Vermicompost), while the minimum length (7.51 cm) was recorded from ON_0 control condition (Table 9).

4.8.8. Effect of different varieties on fruit length

Length of fruit varied significantly due to different varieties of sweet pepper (Appendix VII). The maximum length of fruit (12.67cm) was recorded from C_2

(Lalima), while the minimum length (8.13 cm) was obtained from C_3 (BARI Mistimorich 2) (Table 10).

4.8.9. Combined effect of different organic nutrients and varieties on fruit length

Different varieties and organic nutrients varied significantly due to the interaction effect in terms of length of fruit (Appendix VII). The maximum length of fruit (14.69 cm) was recorded from ON_2C_2, while the minimum length (5.17cm) was observed from ON_0C_3 (Table 11).

4.8.10. Effect of different organic nutrients on fruit weight

Significant variation was recorded for fruit weight of sweet pepper for different organic nutrients (Appendix VII). The maximum fruit weight (240 gm) was found from ON_3 (Vermicompost), while the minimum fruit weight per plant (216.56 gm) was recorded from ON_0 control condition (Table 9).

4.8.11. Effect of different fruit varieties on fruit weight

In the experiment fruit weight varied significantly due to different varieties of sweet pepper (Appendix VII). The maximum fruit weight (237.75 gm) was recorded from C_2 (Lalima), while the minimum fruit weight per plant (215.33 gm) was obtained from C_3 (BARI Mistimorich 2)(Table 10).

4.8.12. Combined effect of different organic nutrients and fruit varieties on fruit weight

Different varieties and organic nutrients varied significantly due to the interaction effect in terms of fruit weight (Appendix VII). The maximum fruit weight per plant(245.00 gm) was recorded from ON_3C_2 which was statistically similar with ON_3C_1, while the minimum fruit weight (199.67 gm) was observed from ON_0C_3(Table 11).

4.8.13. Effect of different organic nutrients on total fruit weight

In the experiment, significant variation was recorded for total fruitweight of sweet pepper for different organic nutrients (Appendix VII). The maximum total fruit weight (2238.30gm) was found from ON_3 (Vermicompost), while the minimum total fruitweight (1093.00gm) was recorded from ON_0 control condition (Table9).

4.8.14. Effect of different varieties ontotal fruit weight

In the experimenttotal fruit weight varied significantly due to different varieties of sweet pepper (Appendix VII). The maximumtotal fruit weight (2018.50gm) was recorded from C_2 (Lalima), while the minimum total fruit weight (1365.60gm) was obtained from C_3 (BARI Mistimorich 2)(Table 10).

4.8.15. Combined effect of different organic nutrients and varieties on total fruitweight

Different varieties and organic nutrients varied significantly due to the interaction effect in terms oftotal fruit weight (Appendix VII). The maximumtotal fruit weight (2646.70gm) was recorded from ON_3C_2 which was followed by with ON_2C_2, while the minimum total fruit weight (798.70 gm) was observed from ON_0C_3(Table 11).

4.8.16. Effect of different organic nutrients on yield per hectare

Significant variation was recorded for yield per hectareof sweet pepper for different organic nutrients (Appendix VII). The maximum yield per hector(11.89 gm) was found from ON_3 (Vermicompost), while the minimum yield per hectare(6.07 gm) was recorded from ON_0 control condition (Table 9).

4.8.17. Effect of different fruit varieties on yield per hectare

Yield per hectareof fruit varied significantly due to different varieties of sweet pepper (Appendix VII). The maximum yield per hectare(10.94 gm) was recorded from C_2 (Lalima), while the minimum yield per hectare(7.05 gm) was obtained from C_3 (BARI Mistimorich 2)(Table 10).

4.8.18. Combined effect of different organic nutrients and fruit varieties on yield per hectare

Different varieties and organic nutrients varied significantly due to the interaction effect in terms of yield per hectare(Appendix VII). The maximum yield per hectare(14.06 gm) was recorded from was recorded from ON_3C_2, while the minimum yield per hectare(4.43 gm) was observed from ON_0C_3(Table 11).

Table 9: Effect of different organic nutrients on number of fruits, fruit diameter (cm), fruit length (cm), fruit weight (g), total fruit weight (g), yield/ha (g) of sweet pepper

Treatment Organic Nutrient	No. of fruit	Fruit diameter (cm)	Fruit length (cm)	Fruit weight (g)	Total fruit weight (g)	yield/ha (ton)
ON_0	5.00 d	4.54 d	7.51 d	216.56 d	1093.00 d	6.07 d
ON_1	6.66 c	5.78 c	9.97 c	225.56 c	1586.20 c	8.39 c
ON_2	7.55 b	7.58 b	11.94 a	231.56 b	1853.40 b	9.77 b
ON_3	8.88 a	8.73 a	11.511 b	240.00 a	2238.30 a	11.89 a
CV%	4.9	1.87	2.82	0.54	0.97	4.94
LSD (0.05)	0.33	0.12	0.28	1.2	16.07	0.43

ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

Table 10: Effect of varieties on number of fruits, fruit diameter (cm), fruit length (cm), fruit weight (g), total fruit weight (g), yield/ha (g) of sweet pepper

Treatment fruit color	No. of fruit	Fruit diameter (cm)	Fruit length (cm)	Fruit weight/plant (g)	Total fruit weight/plot (g)	yield/ha (ton)
C_1	7.00 b	6.49 b	9.90 b	232.17 b	1694.20 b	9.09 b

C_2	8.25 a	7.56 a	12.67 a	237.75 a	2018.50 a	10.94 a
C_3	5.83 c	5.92 c	8.13 c	215.33 c	1365.60 c	7.05 c
CV%	4.9	1.87	2.82	0.54	0.97	4.94
LSD (0.05)	0.29	0.1	0.24	1.02	13.92	0.37

C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2

Table 11: Combined effect of different organic nutrients and varieties on number of fruits, fruit diameter (cm), fruit length (cm), fruit weight (g), total fruit weight (g), yield/ha (g)of sweet pepper

Treatment combination	No. of fruit	Fruit diameter (cm)	Fruit length (cm)	Fruit fresh weight/plant (g)	Total fruit weight/Plot (g)	Yield/ha (ton)
ON_0C_1	5.00 g	4.5333 i	7.040 h	219.67 e	1098.3 i	6.102 f
ON_0C_2	6.00 ef	5.65 g	10.32 e	230.33 d	1382.0 g	7.67 e
ON_0C_3	4.00 h	3.45 j	5.17 i	199.67 g	798.70 j	4.43 g
ON_1C_1	6.66 d	5.74 g	9.58 f	230.00 d	1612.30 e	8.51 d
ON_1C_2	7.66 c	6.61 f	12.52 c	235.00 c	1879.30 d	10.00 c
ON_1C_3	5.66 f	4.99 h	7.81 g	211.67 f	1267.00 h	6.65 f
ON_2C_1	7.33 c	7.26 d	11.51 d	235.33 c	1859.30 d	9.58 c
ON_2C_2	9.00 b	8.45 b	14.69 a	240.67 b	2166.00 c	12.03 b
ON_2C_3	6.33 de	7.03 e	9.63 f	218.67 e	1535.00 f	7.69 e
ON_3C_1	9.00 b	8.45 b	11.46 d	243.67 a	2206.70 b	12.18 b
ON_3C_2	10.33 a	9.54 a	13.15 b	245.00 a	2646.70 a	14.06 a
ON_3C_3	7.33 c	8.22 c	9.91 ef	231.33 d	1861.70 d	9.43 c
CV %	4.9	1.87	2.82	0.54	0.97	4.94
LSD (0.05)	0.58	0.21	0.48	2.08	27.84	0.75

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

ON_0 : Control (No manure application) C_1: Peperone Yolo Wonder
ON_1 : Cowdung C_2: F1 Hybrid Sweet Pepper (Lalima)
ON_3 : Poultry manure C_3: BARI Mistimorich 2
ON_4 : Vermicompost

4.9. Chemical analysis

4.9.1. Effect of different organic nutrients on brix (%)

Significant variation was remarked on brix% as influenced by different organic nutrients (Fig.16). The highest brix% (6.35) recorded from the treatment ON_3 (Vermicompost) which was scientifically different from all other treatment. The lowest brix% (4.5) was recorded from the treatment ON_0(Control).

Contreras *et al. (*2006) reported that an increasing trend in total soluble solids with the increase in levels of poultry manure was observed and the maximum total soluble solids were recorded with the combination of highest levels of poultry manure.

4.9.2. Effect of different fruit varieties on brix (%)

Significant variation was remarked on brix% as influenced by different fruit varieties (Fig.17). The highest brix% (7.15) recorded from the variety C_2 (Lalima)which was scientifically different from all other treatment. The lowest brix% (4.28) was recorded from the variety C_1 (Peperone Yolo Wonder).

Aminifard*et al. (*2012) was reported that, total soluble solids with the increase in levels of dark fruit color was observed and the maximum total soluble solids were recorded with the “BARI misty morich 2”.

4.9.3. Combined effect of different organic nutrients and fruit varieties on brix (%)

Different varieties and organic nutrients varied significantly due to the interaction effect in terms of brix% (Appendix VIII). The maximum brix% (8.06) was recorded from was recorded from ON_3C_2 , while the minimum yield per hector(3.46) was observed from ON_0C_1(Table 12).

4.9.4. Effect of different organic nutrients on anthocyanin determination

Significant variation was recorded foranthocyanin determination of fruit of sweet pepper for different organic nutrients (Fig.16). The maximum anthocyanin determinationof fruit (9.5mg/100 Fw) was found from ON_3 (Vermicompost), while the minimum anthocyanin determination (6.17 mg/100 Fw) was recorded from ON_0 control condition.

4.9.5. Effect of different varieties on anthocyanin determination

In the experiment anthocyanin determination varied significantly due to different varieties of sweet pepper (Fig.17). The maximum anthocyanin determination (8.81 mg/100 Fw) was recorded from C_2 (Lalima), while the minimum fruit weight per plant (6.43 mg/100 Fw) was obtained fromC_1(Peperone Yolo Wonder).

4.9.6. Combined effect of different organic nutrients and varieties on anthocyanin determination

Different varieties and organic nutrients varied significantly due to the interaction effect in terms of anthocyanin determination(Appendix VIII). The maximum anthocyanin conc. (11.00 mg/100 Fw) was recorded from was recorded from

ON_3C_2, while the minimum conc.(5.10 mg/100 Fw) was observed from ON_0C_1(Table 12).

4.9.7. Effect of different organic nutrients on antioxidant activity (%)

Significant variation was recorded forantioxidant activity (%) of sweet pepper for different organic nutrients (Fig. 16). The maximumantioxidant activity of fruit (81.33%) was found from ON_3 (Vermicompost), while the minimumantioxidant activity (72.66%) was recorded from ON_0 control condition

4.9.8. Effect of different varieties on antioxidant activity (%)

In the experiment antioxidant activity (%)varied significantly due to different varieties of sweet pepper (Fig. 17). The maximum antioxidant activity (80.75%) was recorded from C_2 (Lalima), while the minimum antioxidant activity (73.00%) was obtained from C_1 (Peperone Yolo Wonder).

4.9.9. Combined effect of different organic nutrients and varieties on antioxidant activity (%)

Different varieties and organic nutrients varied significantly due to the interaction effect in terms of antioxidant activity (%) (Appendix VIII). The maximum antioxidant activity (86.00%) was recorded from was recorded from ON_3C_2, while the minimum antioxidant activity(69.00%) was observed from ON_0C_1 (Table 12).

4.9.10. Effect of different organic nutrients on vitamin C concentration

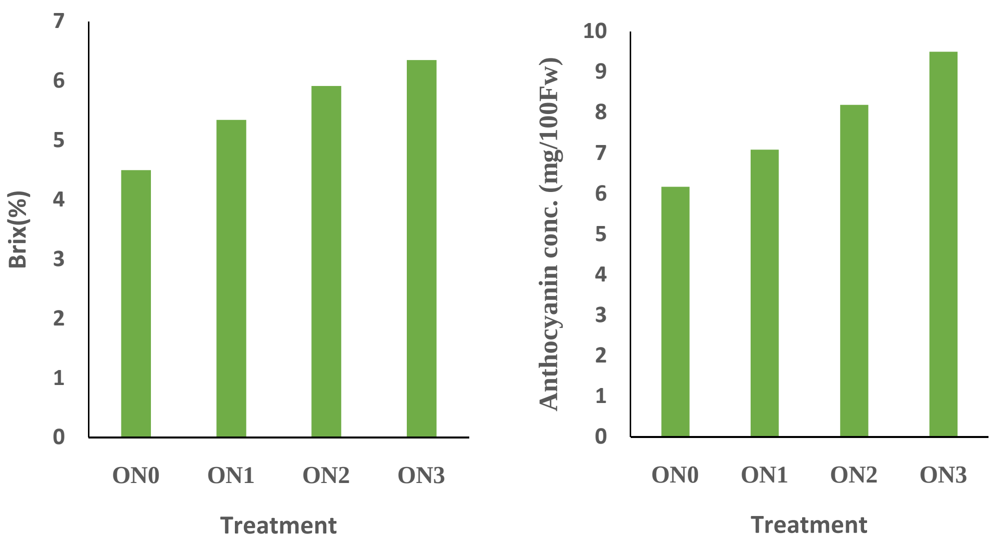
Significant variation was recorded forvitamin C concentrationof fruit of sweet pepper for different organic nutrients (Fig. 16). The maximum vitamin C concentration of fruit (142.44 mg/ 100g of fruit) was found from ON_3 (Vermicompost), while the minimum vitamin C concentration (136.33 mg/ 100g of fruit) was recorded from ON_0 control condition (Table 12).

4.9.11. Effect of different varieties on vitamin C concentration

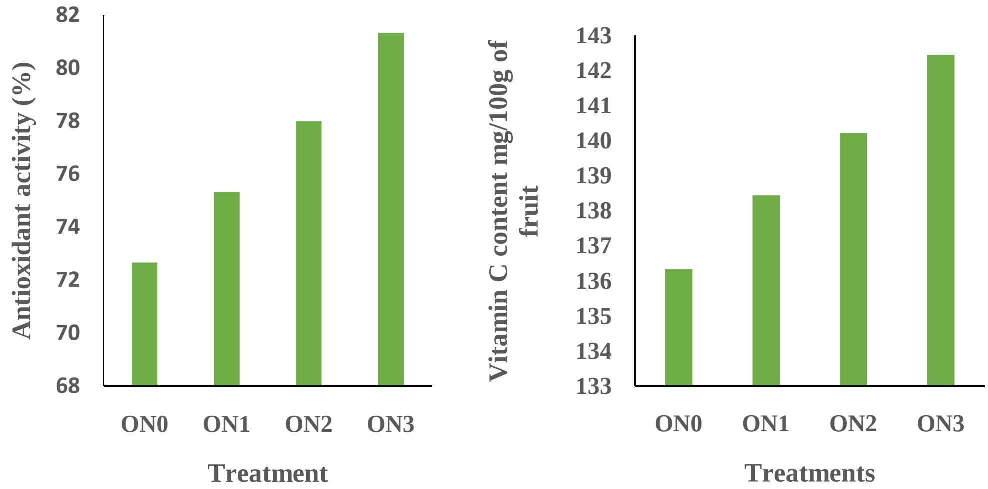
In the experiment vitamin C concentrationsignificantly due to different varieties of sweet pepper (Fig.17). The maximum vitamin C concentration(141.75 mg/ 100g of fruit) was recorded from C_1 (Peperone Yolo Wonder), while the minimum vitamin C concentration(136.33 mg/ 100g of fruit) was obtained from C_3 (BARI Mistimorich 2)

4.9.12. Combined effect of different organic nutrients and varieties on vitamin C concentration

In the experiment, different varieties and organic nutrients varied significantly due to the interaction effect in terms of vitamin C concentration (Appendix VIII). The maximum vitamin C concentration (144.00 mg/ 100g of fruit) was recorded from ON_3C_1, while the minimum vitamin C concentration(133.00 mg/ 100g of fruit) was observed from ON_0C_3(Table 12).



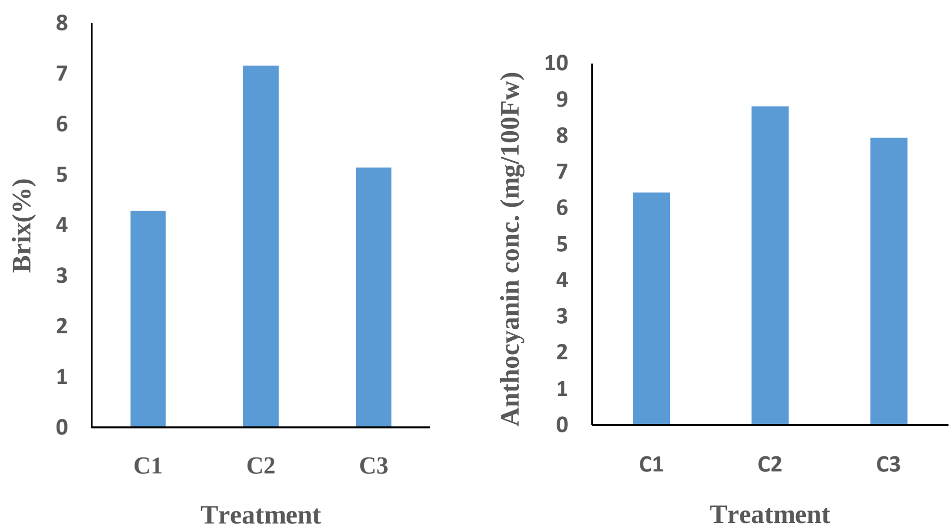
(a) (b)



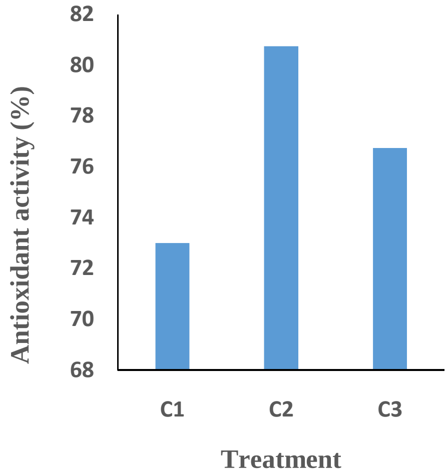
(c) (d)

ON_0: No fertilizer (Control), ON_1: Cowdung, ON_2: Kitchen compost, ON_3: Vermicompost

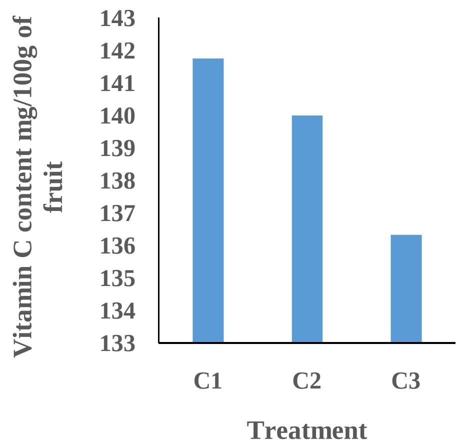
Figure 16: Effect of different organic nutrients on (a) brix (%), (b) anthocyanin determination (c) antioxidant activity (%), (d) vitamin C content of sweet pepper



(a) (b)



(c)



(d)

C1: Peperone Yolo Wonder, C2: F1 Hybrid Sweet Pepper (Lalima), C3: (BARI Mistimorich 2)

Figure 17: Effect of fruit varieties on (a) brix (%), (b) anthocyanin determination (c) antioxidant activity (%), (d) vitamin C content of sweet pepper

Table 12: Combined effect of different organic nutrients and varieties on brix (%), anthocyanin determination, antioxidant activity (%), vitamin C content of sweet pepper

Treatment combinations	Brix (%)	Anthocyanin determination	Antioxidant activity (%)	Vitamin C content
ON_0C_1	3.46 i	5.10 k	69.00 j	139.00 de
ON_0C_2	6.00 d	7.17 g	76.00 ef	137.00 e
ON_0C_3	4.03 h	6.24 i	73.00 hi	133.00 f
ON_1C_1	4.00 h	5.62 j	72.00 i	141.33 bc
ON_1C_2	7.00 c	8.06 e	79.00 c	139.33 cd
ON_1C_3	5.03 f	7.56 f	75.00 fg	134.67 f
ON_2C_1	4.68 g	7.03 h	74.00 gh	142.67 ab
ON_2C_2	7.56 b	9.03c	82.00 b	141.00 bcd

ON_2C_3	5.50 e	8.50 d	78.00 cd	137.00 e
ON_3C_1	5.00 f	8.00 e	77.00 de	144.00 a
ON_3C_2	8.06 a	11.00 a	86.00 a	142.67 ab
ON_3C_3	6.00 d	9.50 b	81.00 b	140.67 bcd
CV %	0.75	0.96	1.09	0.92
LSD (0.05)	0.07	0.12	1.41	2.17

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

ON_0 : Control (No manure application)
ON_1 : Cowdung
ON_3 : Poultry manure
ON_4 : Vermicompost

C_1: Peperone Yolo Wonder
C_2: F1 Hybrid Sweet Pepper (Lalima)
C_3: BARI Mistimorich 2

4.10. Economic analysis

Input costs for land preparation, fertilizer, irrigation and manpower required for all the operations from seed sowing to harvesting of sweet pepper were recorded for unit plot and converted into cost per hectare (Appendix IX). Price of sweet pepper was considered as per market rate. The economic analysis presented under the following headings-

4.10.1. Gross return

The combination of fruit varieties and different organic nutrients showed different values in terms of gross return under the trial (Table 13). The highest gross return (Tk. 2,812,000) was obtained from the treatment combination ON_3C_2 and the second highest gross return (Tk. 2,406,000) was found in ON_2C_2. The lowest gross return (Tk. 732,000) was obtained from ON_0C_1.

4.10.2. Net return

In case of net return, different treatment combination showed different levels of net return under the present trial (Table 13). The highest net return (Tk. 2,505,995) was found from the treatment combination ON_3C_2 and the second highest net return (Tk. 2,097,096) was obtained from the combination ON_2C_2 . The lowest (Tk. 437,145) net return was obtained ON_0C_1.

4.10.3. Benefit cost ratio (BCR)

The combination of different organic nutrients and fruit varieties for benefit cost ratio was different in all treatment combinations (Table 13). The highest benefit cost ratio (9.18) was observed in ON_3C_2. The lowest benefit cost ratio (2.48) was obtained from ON_0C_1. From the economic point of view, it is apparent that ON_3C_2treatment combination was the most profitable one than rest of the treatment combinations under the study.

Table 13: **Economic analysis of sweet pepper cultivation as influenced by different organic nutrients and varieties**

Treatment combinations	Cost of production (Tk/ha)	Yield (t/ha)	Gross return (Tk/ha)	Net return (Tk/ha)	Benefit Cost Ratio
ON_0C_1	294855	6.10	732000	437145	2.48
ON_0C_2	294855	7.67	1534000	1239145	5.20
ON_0C_3	294855	4.43	797400	502545	2.70
ON_1C_1	301545	8.51	1021200	719655	3.38
ON_1C_2	301545	10.00	2000000	1698455	6.63
ON_1C_3	301545	6.65	1197000	895455	3.96
ON_2C_1	308904	9.58	1149600	840696	3.72
ON_2C_2	308904	12.03	2406000	2097096	7.78
ON_2C_3	308904	7.69	1384200	1075296	4.48
ON_3C_1	306005	12.18	1461600	1155595	4.77

ON_3C_2	306005	14.06	2812000	2505995	9.18
ON_3C_3	306005	9.43	1697400	1391395	5.54

ON_0 : Control (No manure application)
ON_1 : Cowdung
ON_3 : Poultry manure
ON_4 : Vermicompost

C_1: Peperone Yolo Wonder
C_2: F1 Hybrid Sweet Pepper (Lalima)
C_3: BARI Mistimorich 2

CHAPTER V
SUMMARY AND CONCLUSION

5.1 Summary

The field experiment was conducted in the Horticulture Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar,Dhaka-1207 during the period from October 2019 to April 2020 to find out the effect of different organic manures and different varieties on the growth and yield of sweet pepper. Two factors were used in the experiment, viz. four types of organic manure and three types of variety. Factor A; Four types of organic manure such as ON_0 - Control (No fertilizer application), ON_1- Cowdung (10 t/ha), ON_2 - Kitchen compost (7 t/ha) and ON_3 -Vermicompost (5 t/ha). Factor B; Three types of variety such as C_1- Peperone Yolo Wonder, C_2 - F1 Hybrid Sweet Pepper (Lalima) and C_3 - BARI Mistimorich 2. The experiment was laid out in a Randomized complete Block Design (RCBD) with three replications. Data on different yield contributing parameters and yield were recorded.

Laboratory experiment was conducted for recording brix %, anthocyanin determination, antioxidant activity %, and vitamin C concentration of fruit with normal (ambient) room temperature (26°C-30°C). Along with these activities benefit cost ratio (BCR) was calculated.

In case of sweet pepper varieties, at 25, 50, 75 and 100 DAT the taller plant (18.09 cm, 32.71 cm, 41.79 cm and 47.70 cm) was recorded from C_2, while the shorter plant (14.02 cm, 24.76 cm, 32.48 cm and 38.29) from C_3. At 25, 50, 75 and 100 DAT, the maximum number of branches per plant (4.25, 5.83, 7.83 and 9.75 cm) was observed from C_2, while the minimum number (2.00, 3.67, 5.17 and 6.33 cm) from C_3. At 25, 50, 75 and 100 DAT, the maximum leaves (17.25, 21.58, 24.67 and 29.67) was recorded from C_2, while the minimum number (12.25, 15.25, 19.83 and 24.00) from C_3. The maximum leaf length at 25, 50, 75 and 100 DAT was measured (14.35, 18.40, 20.64 and 22.94 cm) from $C_{2,}$ while the minimum leaf length (10.25, 12.69, 14.93 and 17.35cm) from C_3. At 25, 50, 75 and 100 DAT, the maximum leaf breadth (6.92, 7.92, 9.74 and 10.87 cm) was observed from C_2, while the minimum leaf breadth (3.96, 5.00, 6.42 and 7.89 cm) from C_3. At 25, 50, 75 and 100 DAT, the maximum canopy size (6.92, 7.92, 9.74 and 10.87 cm) was observed from C_2, while the minimum canopy size (3.96, 5.00, 6.42 and 7.89 cm) from C_3.The maximum number of flowers (4.67, 7.00 and 9.75,) at 25, 50 and 75 DAT was recorded from C_2, while the minimum number (2.58, 4.42 and 7.58) from C_3. The maximum fruits (8.25) was recorded from C_2, while the minimum number (5.83) from C_3. The maximum length of fruit (12.67 cm) was recorded from C_2, while the minimum length (8.13 cm) was found from C_3. The maximum diameter of fruit (7.56 cm) was recorded from C_2, while the minimum diameter (5.92 cm) was obtained from C_3. The maximum weight of fruit (237.75 g) was observed from C_2, while the minimum weight (215.33 g) was found from C_3. The maximum yield per hectare (10.94 ton) was attained from C_2, while the minimum yield per hectare (7.05ton) from C_3.

Due to varieties the maximum amount of brix %, anthocyanin and antioxidant (6.35, 9.50 and 81.33) found from $C_{2,}$ the minimum amount ofbrix %, anthocyanin, and antioxidant (4.5, 6.17 and 72.66) found from $C_{1.}$ On the other hand, the maximum amount of vitamin C (142.44) found from C_1 and minimum amount of vitamin C (136.33) found from $C_{3.}$

For different organic nutrients, at 25, 50, 75 and 100 DAT the longer plant (20.33cm, 35.44cm, 48.82 cm and 53.88 cm) was recorded from ON_3, while the shorter plant (12.62cm, 20.22 cm, 25.33 cm and 27.44 cm) from ON_0 . At 25, 50, 75 and 100 DAT, the maximum number of branches per plant (5.22, 6.89, 8.67 and 10.33 cm) was observed from $ON_{3,}$ while the minimum number (1.33, 2.33, 3.67 and 4.67 cm) from ON_0. At 25, 50, 75 and 100 DAT, the maximum number of leaves per plant (21.78, 26.78, 33.00 and 39.33) was recorded from ON_3, while the minimum number (8.78, 10.44, 12.56 and 15.56) from ON_0. The maximum number of leaf leanth at 25, 50, 75 and 100 DAT were (16.00, 20.64, 23.94 and 25.71cm) from $ON_{3,}$ while the minimum number of leaf leanth (9.35, 10.41, 11.42 and 13.78 cm) from ON_0 . At 25, 50, 75 and 100 DAT, the maximum leaf breadth (6.90, 8.28, 10.14 and 11.45 cm) was observed from ON_3, while the minimum leaf breadth (3.32, 4.07, 5.01 and 6.29 cm) from ON_0. At 25, 50, 75 and 100 DAT, the maximum canopy size (6.90, 8.28, 10.14 and 11.45 cm) was observed from ON_3, while the minimum of canopy size (3.32, 4.07, 5.01 and 6.29 cm) from ON_0.The maximum number of flowers per plant (5, 8, 10 and 12) at 25, 50 and 75 DAT was recorded from ON_3, while the minimum number of flower (2, 3, 4 and 5) from ON_0. The maximum number of fruits per plant (8.88) was recorded from ON_3, while the minimum number (5.00) from ON_0. The maximum length of fruit (11.51 cm) was recorded from ON_3, while the minimum length (7.51 cm) was found from ON_0. The maximum diameter of fruit (8.73 cm) was recorded from C_2, while the minimum diameter (4.54 cm) was obtained from ON_0. The maximum weight of fruit per plant (240 g) was observed from ON_3, while the minimum weight (216.56 g) was found from ON_0. The maximum yield per hectare (11.89 ton) was attained from ON_3, while the minimum yield per hectare (6.07 ton) from ON_0.

For different organic nutrients the maximum amount of brix %, anthocyanin, antioxidant and vitamin c concentration (8.06, 11.00, 86.00 and 144.00) found from $ON_3C_{2,}$ the minimum amount ofbrix %, anthocyanin, and antioxidant (3.46, 5.10 and 69.00) found from $ON_0C_{1,}$ while the minimum amount of vitamin c (133.00) found from $ON_0C_{3.}$

Due to the interaction effect of different organic nutrients and varieties, at 25, 50, 75 and 100 DAT the longer plant (24.66, 17.66, 18.50 and 17.83 cm) was recorded from ON_3C_2, while the shorter plant (11.00, 18.00, 24.00 and 26.00 cm) from ON_0C_3. At 25, 50, 75 and 100 DAT, the maximum number of branches per plant (6.66, 7.66, 10.33, and 13.00) was observed from ON_3C_2, while the minimum number (1.00, 1.66, 3.00 and 4.00) from C_3. At 25, 50, 75 and 100 DAT, the maximum number of leaves per plant (25.00, 32.00, 36.00 and 42.00) was recorded from ON_3C_2 , while the minimum number (6.66, 8.66, 11.00 and 13.00) from ON_0C_3. The maximum number of leaf leanth at 25, 50, 75 and 100 DAT were (17.66, 24.33, 27.44 and 28.83 cm) from $ON_3C_{2,}$ while the minimum number of leaf leanth (7.66, 8.56, 9.34 and 12.00 cm) from ON_0C_3 . At 25, 50, 75 and 100 DAT, the maximum leaf breadth (8.83, 10.01, 12.94 and 13.91cm) was observed from ON_3C_2, while the minimum leaf breadth (2.70, 3.31, 4.00 and 5.31cm) from ON_0C_3. At 25, 50, 75 and 100 DAT, the maximum canopy (8.83, 10.01, 12.94 and 13.91 cm) was observed from ON_3C_2, while the minimum canopy (2.70, 3.31, 4.00 and 5.31cm) from ON_0C_3.The maximum number of flowers per plant (6.00, 10.00 and 13.00) at 25, 50 and 75 DAT was recorded from ON_3C_2, while the minimum number of flower (1.00, 2.00 and 5.00) from ON_0C_3 . The maximum number of fruits per plant (10.33) was recorded from ON_3C_2, while the minimum number (4.00) from ON_0C_3 . The maximum length of fruit (14.69 cm) was recorded from ON_3C_2, while the minimum length (5.17cm) was found from ON_0C_3. The maximum diameter of fruit (9.54 cm) was recorded from ON_3C_2, while the minimum diameter (3.45 cm) was obtained from ON_0C_3. The maximum weight of fruit per plant (245.00 g) was observed from ON_3C_2 , while the minimum weight (199.67g) was found from ON_0C_3. The maximum yield per hectare (14.06 ton) was attained from ON_3C_2, while the minimum yield per hectare (4.43 ton) from $ON_0C_{3.}$

Due to interaction the maximum amount of brix %, anthocyanin, antioxidant and vitamin C concentration (8.06, 11.00, 86.00 and 144.00) found from $ON_3C_{2,}$ the minimum amount ofbrix %, anthocyanin, and antioxidant (3.46, 5.10 and 69.00) found from $ON_0C_{1,}$ while the minimum amount of vitamin C (133.00) found from $ON_0C_{3.}$

The highest gross return (Tk. 2,812,000) was obtained from the treatment combination ON_3C_2 and the lowest gross return (Tk. 732,000) from ON_0C_1. The highest net return

(Tk. 2,505,995) was found from ON_3C_2 and the lowest (Tk. 437,145) net return was obtained ON_0C_1. The highest benefit cost ratio (9.18) was noted from ON_3C_2 and the lowest benefit cost ratio (2.48) was obtained from ON_0C_1 .

5.2 Conclusion

Considering different organic manures and varieties on growth and yield of sweet pepper it may be concluded that the treatment combination of vermi compost and "F1 Hybrid Sweet Pepper (Lalima)" performed the best results. So, the treatment combination of vermi compost and "F1 Hybrid Sweet Pepper (Lalima)" is the superior combination compared to other treatment combinations for sweet pepper production. The experiment was conducted only one growing season. So, considering the situation of the present experiment, further studies in the following areas may be suggested:

1. Such study is needed in different agro-ecological zones (AEZ) of Bangladesh for regional adaptability and other performances;
2. Another doses of Organic manure may be included in the future program;
3. Other varieties may be included in the further program.

REFERENCES

Abdulbaki, A.S. (2019). The efficacy of poultry manure on the growth and yield of two capsicum species: *Capsicum annum* and *Capsicum frutescens*. *FUDMA J. Sci*. **3**(1):28-32.

Adesina, J.M., Sanni, K.O., Afolabi, L.A., Eleduma, A.F. and Academia Arena.(2014).The use of vermicompost in sustainable agriculture: Impact on plant growth and soil fertility**6**(1): 9-13.

Adhikari, P. Khanal, A. and Subedi, R. (2016). Effect of different sources of organic manure on growth and yield of sweet pepper. *Adv Plants Agric Res.***3** (5):158–161.

Akande, T.Y., Fagbola, O., Erinle, K.O., Bitire, T.D., and Urhie, J. (2018). Effect of organic manure and Mycorrhizal on the growth and yield of *Capsicum annum* (Hot pepper). *New York J.Sci.***11**(5):1-9.

Albiach, K.P., Jha, M.M. and Sanjeev, K. (2000). Influence of organic manure, irrigation interval and cropping sequence on the yield and black scurf disease of chilli, Dept, Path, Rajendra Agric. Univ. Pusa, Samastipur (Bihar). *IndiaAgric. Bio. Res.*, **5**(9): 128-136.

Ali, M.R., Mehraj, H. and Jamal Uddin, A.F.M. (2014). Foliar Application of the leachate from Vermicompost and mustard oil cake on the Growth and Yield of Summer Tomato. *Middle-East J. Sci. Res.*, **22**(8): 1233-1237.

Ali, M.N., Ghatak, S. and Ragul, T. (2011). Biochemical analysis of Panchagavya and Sanjibani and their effect in crop yield and soil health. *J. Crop Weed*,**7**(2): 84-86.

Aliyu, L. (2000). The effect of organic and mineral fertilizers on growth, yield and composition of pepper (Capsicum annuum L.). Biological Agriculture and Horticulture, **18**(1), 29-36.

Aminifard, M.H., Aroiee, H., Ameri, A., and Fatemi, H. (2012). Effect of plant density and nitrogen fertilizer on growth, yield and fruit quality of sweet pepper (C. annum L.). *African J.Agri. Res.***7**(6): 859-866.

Amor, F.M. (2006). Yield and fruit quality response of sweet pepper to organic and mineral fertilization. Agriculture and Food system. **22**(3):233-238.

Awosika, O.E, Awodun, M.A. and Ojeniyi, S.O. (2015). Comparative effect of pig manure and NPK fertilizer on Agronomic performance of Tomato (*Lycopersicon ensculentum Mill*). *American J. Expt. Agric.***4**(11): 1330-1338.

BARI. (1989). Annual Report (1987-88) of Bangladesh Agriculture Research Institute. Joydebpur, Gazipur. p. **133**.

Bosland, P.W. and Vatava, E.J. (2000). Peppers, vegetables and spices capsicum (p. **204**). CABI publishing, Wallingford, UK. Retrieved from

Chaudhary, B.R., Sharma, M.D., Shakya, S.M. and Gautam, D.M. (2006). Effect of plant growth regulators on growth, yield and quality of chilly (*Capsicum annuum* L.) at Rampur, Chitwan. *J. Inst. Agric. Anim. Sci.*, **27**: 65-68.

Contreras, J.I., Segura, M.L., Galindo, P., and Catala, J.J. (2006). Response of greenhouse pepper crop to fertilizer level and different qualities of irrigation water. Acta Horticulture, 700: 203-206.

Cristina, L. and Jorge, D. (2011). The use of vermicompost in sustainable agriculture: Impact on plant growth and soil fertility. In: Soil Nutrients, *Nova Sci.*, **10**: 2-16.

Fabiyi, E.F., Oluwafemi, A.B. and Joseph, A. (2015).Comparative evaluation of organic and inorganic manure on sweet pepper performance in two ecological zones of Nigeria. *American J. Expt. Agric*. **6**(5):305-309.

Fawzy, Z.F., El-Bassiony, A.M., Yunsheng, L., Zhu, O. and Ghoname, A.A. (2012). Effect of mineral, organic and bio-N fertilizers on growth, yield and fruit quality of sweet pepper. *J. Appl. Sci. Res*. **8**(8): 3921-3933.

Fioreze, C. and Ceretta, C.A. (2006). Organic sources of nutrients in potato production systems. Extensao Rural do RS (EMATER/RS-ASCAR), Brazil. Ciencia Rural. **36**(6): 1788-1793.

Flores, P., Hellin, P. and Fenoll, J. (2009). Effect of manure and mineral fertilization on pepper nutritional quality. *Journal of Science, Food and Agriculture*. **89**(9):1581–1586.

Goutam, K.H., Goutam, B. and Susanta, K.C. (2011). The effect of vermicompost and other fertilizers on cultivation of tomato plants. *J.Hort. Forest.* **3**(2): 42-45.

Handa, G.K., Bhunia, G. and Chakraborty, S.K. (2011). The effect of vermicompost and other fertilizers on cultivation of tomato plants. *J. Hort. and Forest.* **3**(2): 42-45.

Hatamzadeh, A. and Masouleh, S.S.S. (2011). The influence of vermicompost on the growth and productivity of cymbidiums. *Caspian J. Environ. Sci.* **9**(2): 125-132.

Hasanuzzaman, S.M., Hossain, S.M.M., Ali, M.O., Hossain, M.A. and Hannan, A. (2007). Performance of Different Bell Pepper (*Capsicum annuum* L.) Genotypes in Response to Synthetic Hormones. *Int. J. Sustain. Crop Prod*., **2**(5): 78-84.

Hasanuzzaman, S.M. (1999). Effect of hormone on yield of bell pepper ***(Capsicum annum*** L). MS thesis, BAU, Mymensingh.

Ikeh, A.O., Udoh, E.I, Uduak, G.I, Udounag, P.I. and Etokeren, U.E. (2012). Response of cucumber (*Cucumis sativus* L.) to different rates of goat and poultry manure on an ultisol. *Agricultural J. Soci. Rese*. **12**(2):132-139.

Ishtiyaq, A.N., Anisa, B.K. and Abdul, H. (2015). Effect of macro phytever micompost on growth and productivity of brinjal (*Solanum melongena*) under field conditions. *Int. J. Recycl. Org. Waste. Agric.* **4**:73–83.

Jadczak, D., Grzeszczuk, M. and Kosecka, D. (2010). Quality characteristics and content of mineral compounds in fruit of some cultivars of sweet pepper (*Capsicum annuum* L.). *J Elementol*.**15** (3):509–515.

Khalid, S., Qureshi, K.M., Hafiz, I.A., Khan, K.S. and Qureshi, U.S. (2013). Effect of organic amendments on vegetative growth, fruit and yield quality of strawberry. *Pakistan J. Agric. Res.* **26**(2).

Khandaker,M.M., Rohani,F., Dalorima,T. and Mat,N. (2017). Effects of different organic fertilizers on growth, yield and quality of *Capsicum Annuum* L. Var. Kulai (Red Chilli Kulai). *Biosciences Biotechnology ResearchAsia.* **14**(1): 185-192.

Kumar, C.A., Rao, G.R. and Chalam, M.S.V.(2013). Efficacy of botanicals with organic manures and fertilizers on Brinjal pests. *Indian J. Entom.* **75**(1): 1-8.

Kushwah, V.S., Singh, S.P., and Lal, S.S. (2005). Effect of manures and fertilizers on potato (*Solanum tuberosum*) production. India. *Potato J.* **32**(3/4): 157-158.

Lallawmsanga, D.J., Mukesh, K.M.D., Balakumaran, M., Ravi, K.J., Jeyarathi, J.K. and Kalaichelvan, P.T. (2012). Ameliorating effect of vermicompost and cow dung compost on growth and biochemical characteristics of *Solanum melongena* L. treated with paint industrial effluent. *Annals Bio. Res.***3**(5): 2268-2274.

Mamta, K., Khursheed A.W. and Rao, R.J. (2012). Effect of vermicompost on growth of chilli plant under field conditions. *J. New Bio. Rep.* **1**(1): 25-28.

Meena, M.L., Kumar, R., Ram, R.B. and Lata, R. (2012). Effect of nitrogen, phosphorus on growth, flowering, fruiting and yield of tomato (*Lycopersicon esculentum* Mill.). *Annals of Horticulture*. **5**: 63-68.

Messraen, C.M. (1992). The Tropical Vegetable Garden. Macmillian (London). p. 235.

Nileema, S.G. and Sreenivasa, M.N. (2011). Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* Mill.) in the sterilized soil. *Karnataka J. Agric. Sci.* **24**(2): 153-157.

Olawuyi, O.J, Odebode, A.C, Babalola, B.J, Afolayan, E.T. and Onu, C.P. (2014). Potentials of Arbuscular Mycorrhiza Fungus in Tolerating Drought in Maize (*Zea mays* L). *American J. Plant. Sci*. **5**: 779-786.

Panajotov, N.D. (1998). Sweet Pepper response to the application of the plant growth regulator a tonic. New Zealand Journal of Crop and Horticultural Science. Keyword: Sweet pepper, yield, morphological behavior, quality, plant growth regulators, a tonic.

Rehman, B., Ganai, M.A., Parihar, K., Asif, M. and Siddiqui, M.A. 2015. Biopotency of Oilcake against *Meloidogyne incognita* affecting *Vignamungo*. *Asian J. Crop Sci.* **7**(2): 128-137.

Reshid, A., Tesfaye, S. and Tesfu, K. (2014). Effects of different rates of vermicompost as potting media on growth and yield of tomato (*Solanum lycopersicum* L.) and soil fertility enhancement. Indian *J. SoilSci. Env.* **3**(7):73-77.

Saha, S.R. and Hossain, M.M. (2001). Heat Tolerance in sweet pepper.Ph.D thesis, BSMRAU, Gazipur. P-83-84.

Sathish, K., Raguraman, S. and Ganapathy, N. (2009). Biorational effects of organic manures, botanicals and bio pesticides against tomato fruit borer, *Helicoverpa armigera* and its egg parasitoid, *Trichogamma chilonis*. *Madras J.* Agric. **96**(1/6): 243-250.

Sharma, N., Shukla, Y.R., Thakur, K.S., Mehta, D.K., Singh, U. and Gupta, R.K. (2017). Assessment of growth and yield and nutrient parameters of bell pepper (*Capsicum annum L*.) as influenced by conjoint applications of organic manure, PGPR, and varying levels of inorganic fertilizers. *International J. Curr. Microbiol. App. Sci*. **6**(10):1780-1789.

Sharma, H.G., Narendra, A., Dubey, P. and Dixit, A. (2004). Comparative performance of capsicum under controlled environment and open field condition. *Ann. Agric. Res*. **25**(4): 638-640.

Singh, B.K., Pathak, K.A., Boopathi, T. and Deka, B.C. (2010). Vermicompost and NPK fertilizer effects on morpho physiological traits of plants yield and quality of tomato fruits. *Vegetable Crops Research Bulletin*.**73**:77-86.

Singh, S. P. and Kushwah, V. S. (2006). Effect of integrated use of organic and inorganic sources of nutrients on potato (*Solanum tuberosum*) production. *Indian J. Agron*. **51**(3): 236-238

Singh, G.B., and Yadav, D.V. (1992). Integrated plant nutrition system in sugarcane. Fertilizer News **37**:15-22.

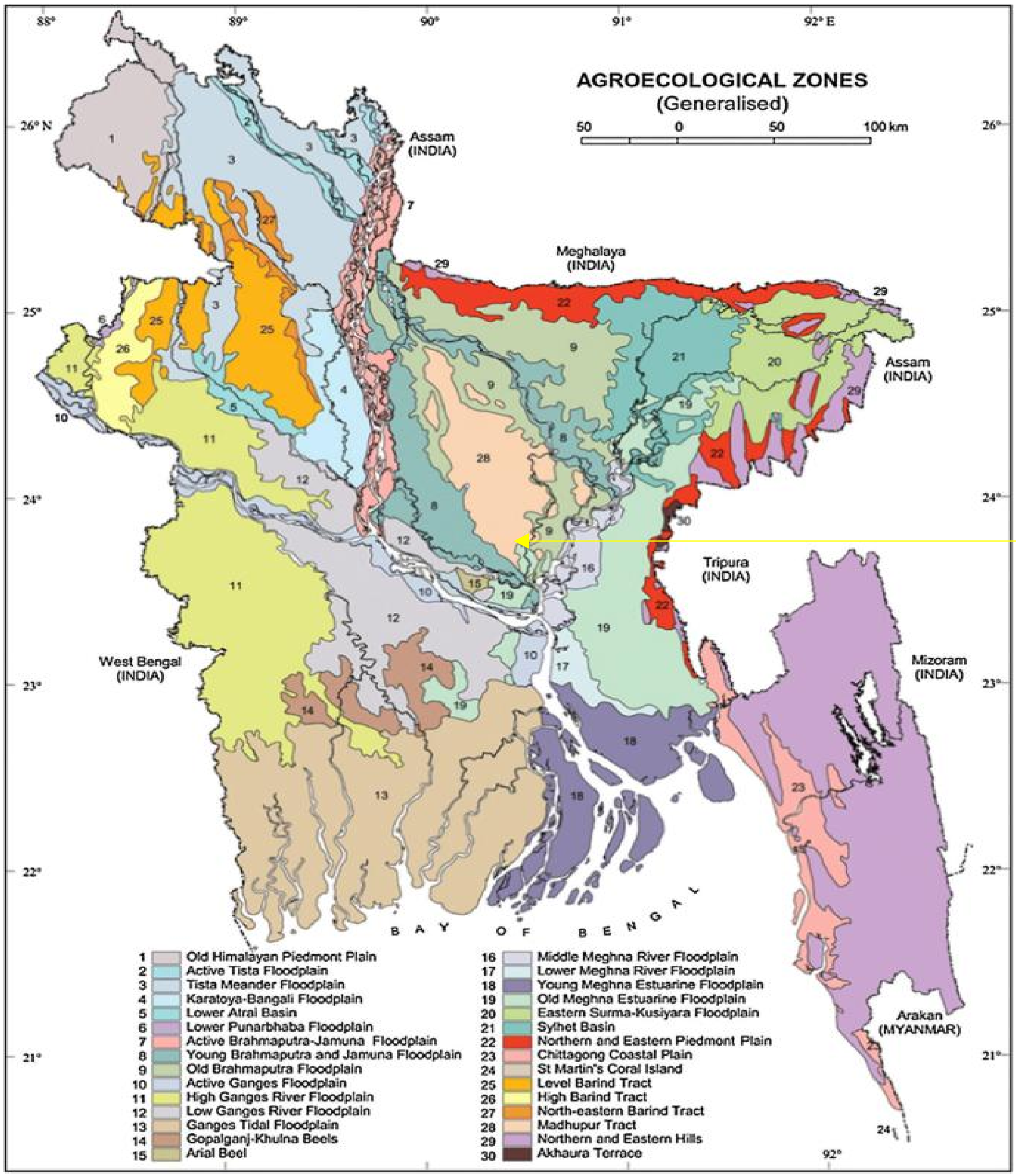
Tajungsola, J., Vijay, B.R., Prasad, V.M. and Lyngdoh, C. (2017). Effect of Organic Manures and Chemical Fertilizers on Growth and Yield of Sweet Pepper (*Capsicum annuum* L.) Hybrid Indam Bharath in Shade Net Condition. *Int.J.Curr.Microbiol.App.Sci.* **6**(8): 1010-1019.

Tsormpatsidis, E., Henbest, R.G.C., Battey, N.H. and Hadley, P. (2010). The influence of ultraviolet radiation on growth, photosynthesis and phenolic levels of green and red lettuce: potential for exploiting effects of ultraviolet radiation in a production system. *Ann. Appl. Biol*. **156**:357–366.

Udoh, D.J., Ndon, B.A., Asuquo, P.E. and Ndaeyo, N.U. (2005). Crop Production Techniques for the Tropics. Concept Publication, Lagos, Nigeria. p. 446.

APPENDICES

Appendix I: Map showing the experimental site



The experimen

Appendix II: Monthly record of air temperature, relative humidity, rainfall and sunshine hour of the experimental site during the period from October 2019 to April 2020

Month	Air temperature (ºC)	Relative humidity	Total Rainfall	Sunshine (hr)

	Maximum	Minimum	(%)	(mm)	
October 2019	31.29	21.55	44%	204	206.9
November 2019	33.4	24.2	54%	00	235.2
December 2019	34.36	26.00	61%	00	290.5
January 2020	33.26	26.9	67%	05	197.6
February 2020	32.54	27.26	74%	03	220.5
March 2020	32.24	22.10	78%	160	208.2
April 2020	30.22	20.76	80%	170	200.6

Sources: Bangladesh Meteorological Department (climate and weather division) Agargoan, Dhaka-1207

Appendix III: Soil characteristics of experimental field as analyzed by Soil Resource Development Institute (SDRI), Khamarbari, Farmgate, Dhaka

A. Morphological characteristics of the experimental field

Morphological features	Characteristics

Location	Experimental field,SAU,Dhaka
AEZ	Madhupur Tract (28)
General Soil type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained

B: Physical and chemical properties of the soil before setting the experiment

Characteristics	Value
PARTIAL SIZE ANALYSIS	
% Sand % Silt % Clay	28 42 30
TEXTURAL CLASS	
pH Organic carbon (%) Organic matter (%) Total N (%) Available P (PPm) Exchangeable K (me/100 gm soil) Available S (PPm)	5.6 0.46 0.80 0.05 20.00 0.12 46

Appendix IV: Analysis of variance of the data on plant height (cm) and number of leaves of sweet pepper plant as influenced by different organic nutrients and varieties

Source of Variation	Degrees of freedom (df)	Mean Square					
		plant height (cm) at				N	
		25 DAT	50 DAT	75 DAT	100 DAT	25 DAT	5
Replication	2	0.746	4.556	3.533	1.94	0.028	
Organic Nutrients (ON)	3	100.481**	361.770**	884.709**	1133.34**	293.806**	51
Fruit color (FC)	2	54.813**	198.165**	279.633**	307.92**	90.778**	12
ON X FC	6	4.069**	15.789**	35.488**	41.23**	1.444**	4
Error	22	0.585	0.993	0.841	0.87	0.149	

*: Significant at 0.05 level of probability**: Significant at 0.01 level of significance

Appendix V: Analysis of variance of the data on number of branches and length of leaves (cm) of sweet pepper as influenced bydifferent organic nutrients and varieties

Source of Variation	Degrees of freedom (df)	Mean Square						
		Number of branches at				length of leaves		
		25 DAT	50 DAT	75 DAT	100 DAT	25 DAT	50 DAT	75 I
Replication	2	0.2500	0.0278	0.2500	1.8611	3.7089	2.553	2.2
Organic Nutrients (ON)	3	25.1111**	33.0648**	39.3333**	50.3981**	79.0569**	**230.849****	**338**
Fruit color (FC)	2	15.7500**	14.1944**	22.3333**	36.1944**	50.7755**	98.975**	100
ON X FC	6	0.5278**	0.5648**	0.8889**	1.7870**	0.5832	1.769**	1.0
Error	22	0.0682	0.1187	0.2500	0.4672	0.4335	0.361	0.20
*: Significant at 0.05 level of probability**: Significant at 0.01 level of significance								

Appendix VI: Analysis of variance of the data on breadth of leaves (cm) , canopy size (cm) and number of flowers of sweet pepper as influenced by organic nutrients and varieties

Source of Variation	Degrees of freedom (df)	Mean Square										
		Breadth of leaves (cm) at				Canopy size (cm) at				number of flowers at		
		25 DAT	50 DAT	75 DAT	100 DAT	25 DAT	50 DAT	75 DAT	100 DAT	25 DAT	50 DAT	75 DAT
Replication	2	0.2003	0.0178	0.2845	1.0901	0.7877	0.3906	1.5615	0.683	0.4444	1.0278	1.5833
Organic Nutrien	3	20.1803**	29.8515**	42.4812**	43.3378**	30.2744**	44.6794**	36.2911**	180.442**	11.8889**	55.1389**	73.3611**

ts (ON)												
Fruit color (FC)	2	27.8938**	25.7871**	33.5370**	27.6474**	43.4358**	70.6404**	97.5473**	225.116**	13.0278**	20.194**	14.3333**
ON X FC	6	0.921**	0.6539**	1.4176**	0.7797**	0.9002**	2.7049**	3.2242**	6.937**	0.0278	0.3056*	0.3333
Error	22	0.0381	0.0742	0.0916	0.1483	0.0911	0.1111	0.2738	0.112	0.0808	0.1187	0.2197
*: Significant at 0.05 level of probability**: Significant at 0.01 level of significance												

Appendix VII: Analysis of variance of the data on number of fruits, fruit diameter (cm), fruit length (cm), fresh fruit weight total fruit weight per plot and yield per hector of sweet pepper as influenced by organic nutrients and varieties

Source of Variation	Degrees of freedom (df)	Mean Square				
		Number of fruits	Fruit diameter (cm)	Fruit length (cm)	Fresh fruit weight/plant (g)	T w
Replication	2	1.0278	0.0038	0.1418	1.33	39
Organic Nutrients (ON)	3	23.9537**	31.2326**	36.1322**	878.69**	20
Fruit color (FC)	2	17.5278**	8.3212**	62.7507**	1634.08**	12

ON X FC	6	0.2315	0.1764**	0.6796**	37.08**	74
Error	22	0.1187	0.0155	0.0835	1.52	2

*: Significant at 0.05 level of probability **: Significant at 0.01 level of significance

Appendix VIII:Analysis of variance of the data on brix % of fruit, anthocyanin, antioxidant and vitamin C determination of sweet pepper as influenced by organic nutrients and varieties

Source of Variation	Degrees of freedom (df)	Mean Square			
		Brix (%)	Anthocyanin determination	Antioxidant activity (%)	Vitamin C
Replication	2	0.0008	0.0449	4.333	30.7778
Organic Nutrients (ON)	3	5.7791**	18.5350**	123.667**	60.7685**
Fruit color (FC)	2	26.0765**	17.4135**	180.250**	91.6944**
ON X FC	6	0.0528**	0.2662**	0.917	1.7685
Error	22	0.0017	0.0056	0.697	1.6566

*: Significant at 0.05 level of probability **: Significant at 0.01 level of significance

Appendix IX. Economic analysis of the experiment

A.Input cost (Tk. /ha)

Treatment combination	Labor cost (Tk)	Ploughing cost (TK)	Seed cost (Tk)	Irrigation cost (Tk)	Pesticide cost (Tk)	Weeding cost (Tk)	Materiel's cost (Tk)	Cowdung 600 tk/t	Kitch comp 1800 tk/t
ON_0C_1	50000	8500	3000	5500	5000	5000	100000	0	0
ON_0C_2	50000	8500	3000	5500	5000	5000	100000	0	0
ON_0C_3	50000	8500	3000	5500	5000	5000	100000	0	0
ON_1C_1	50000	8500	3000	5500	5000	5000	100000	6000	0
ON_1C_2	50000	8500	3000	5500	5000	5000	100000	6000	0
ON_1C_3	50000	8500	3000	5500	5000	5000	100000	6000	0
ON_2C_1	50000	8500	3000	5500	5000	5000	100000	0	12600
ON_2C_2	50000	8500	3000	5500	5000	5000	100000	0	12600
ON_2C_3	50000	8500	3000	5500	5000	5000	100000	0	12600
ON_3C_1	50000	8500	3000	5500	5000	5000	100000	0	0
ON_3C_2	50000	8500	3000	5500	5000	5000	100000	0	0
ON_3C_3	50000	8500	3000	5500	5000	5000	100000	0	0

B.Overhead cost(Tk. /ha)

Treatment combination	Cost of lease of land (13% of value of land Tk. 15,00000/year)	Miscellaneous cost (Tk. 5% of the input cost)	Interest on running capital for 6 months (Tk. 13% of cost/year)	Subtotal (Tk) (B)	Total cost of production (Tk./ha) [Input cost (A) + overhead cost (B)]
ON_0C_1	97500	8850	11505	117855	294855
ON_0C_2	97500	8850	11505	117855	294855
ON_0C_3	97500	8850	11505	117855	294855

ON_1C_1	97500	9150	11895	118545	301545
ON_1C_2	97500	9150	11895	118545	301545
ON_1C_3	97500	9150	11895	118545	301545
ON_2C_1	97500	9480	12324	119304	308904
ON_2C_2	97500	9480	12324	119304	308904
ON_2C_3	97500	9480	12324	119304	308904
ON_3C_1	97500	9350	12155	119005	306005
ON_3C_2	97500	9350	12155	119005	306005
ON_3C_3	97500	9350	12155	119005	306005